ELECTRICAL REVIEW
AND
WESTERN ELECTRICIAN

VOL. LIV. No. 8. CHICAGO, SATURDAY, FEBRUARY 20, 1909. ISSUED WEEKLY

BY THE
ELECTRICAL REVIEW PUBLISHING COMPANY.
CHARLES W. PRICE, President.
H. S. TUTHILL, Secretary. PHILIP S. DODD, Manager.
C. W. FORBRICH, Assistant Treasurer.

PUBLICATION OFFICE: 204 DEARBORN STREET, CHICAGO.

EASTERN DEPARTMENT . . . . . 13 Park Row, New York.
E. E. Wood.
EUROPEAN OFFICE . . . . . 42 Old Broad Street, London, E. C.
Henry W. Hall.

A. A. GRAY, Managing Editor.

The present publication comprises: ELECTRICAL REVIEW, VOL. LIV, No. 8; WESTERN ELECTRICIAN, VOL. XLIV, No. 8.

SUBSCRIPTIONS

One Year, United States	$3.00
One Year, Canada	4.00
One Year, Foreign Countries	6.00
Single Copy, 10 cents. Back numbers, beyond one month, each	.25

Changes of address reaching this office later than Monday cannot be made until the issue next following.

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

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COMBINING BOILER ROOMS IN POWER PLANT EXTENSIONS.

A question which sometimes causes trouble in the extension of a power plant is whether the new and old boiler rooms shall be combined and operated as one group of steam generators under a single roof, or whether a separate installation and independent operation shall be provided. There are advantages on each side of this question. In the case of the separate installation, increased reliability of service and sometimes reduced cost of construction apply. If anything happens to put the initial boiler installation out of service, a separate outfit need not be interrupted if the two rooms are actually isolated, even though their steam mains and leads to different prime movers may be multipled. There is no reasonable doubt that a much wider range of accidents can be sustained in the case of the separate boiler installations, without entire interruption of the service. Again, where the expansion of the original boiler room can take place only along lines of heavy construction expense and often cramped room for working and inspection, it may easily prove to be cheaper in first cost to install the new boilers in a separate room, without providing any wide open physical connection between the old and the new portions of the plant.

The separate plant can scarcely expect the same economy of operation, however, that should be enjoyed by the single, combined old and new equipment under one roof. In general, additional coal-handling facilities can be added at less expense to an existing installation than designed and erected for an entirely separate boiler plant. The coal storage of a larger room will, in general, be less costly than for two boiler plants of comparable size, which are separated. If there is plenty of room on all sides of the station for expansion, it will usually be cheaper to extend an existing boiler room than to build a separate one. The advantages of concentration undoubtedly mean less cost for attendance, and, incidentally, less anxiety on the part of the boiler-room foreman. A hard and fast solution is clearly out of the question, considering the number of factors bearing on it. In a specific case it is therefore advantageous to consider the relative first cost of the separate and combined installations, the cost of space and provision, or lack of it, for expansion in the initial plant design, the capacity of existing flues and stacks, fans and economizers, if any are in service, possibility of installing the piping so that a break or boiler failure in one part of the plant shall not stop the operation of the newer or older batteries, as the case may be, accessibility of the different portions of the plant and the labor needed to handle the installation, relative cost of installing

and operating additional coal-handling facilities, if mechanical fuel control is employed, and finally, the possibility of further expansion to the ultimate capacity of the plant as a whole.

A typical illustration of a plant where the installation of a separate boiler room seemed the best solution is afforded by the Springfield (Mass.) station of the United Electric Light Company. When growth of business called for additional facilities, it was decided by the officers of this company to install a steam-turbine equipment of several thousand kilowatts capacity, with additional boilers and auxiliary equipment. The initial steam station of the company is located on the shore of the Connecticut River at the foot of State Street, and on the east side of the plant, cutting off expansion in that direction, are the main-line tracks of the New York, New Haven & Hartford Railroad system. A narrow space between the railroad tracks and the power house is utilized for coal storage, and the coal is handled from this storage into the crusher and conveying system of the original station by a locomotive hoist operated by electric power. It was decided to install the new turbines in a separate building, practically adjoining the engine room of the old station, and the boilers for the new units were set up in a new room behind the new turbines. The company thus built a new plant complete alongside its initial station, while it preserved the old plant's identity and placed the electric generating units close enough together to enable the plant as a whole to be operated as a unit if desired. The boiler rooms are separated by more than the length of the original engine room, but it is possible for the company, at any time it wishes, to connect the main steam headers together, so that in case of trouble in one boiler room steam can be furnished from the other one except in the event of both sets of batteries being worked at full load on their most immediate prime movers. The problem of coal supply to the new boiler room was solved by the use of the locomotive crane, whose track has merely been extended sufficiently to serve the crusher and conveyor system of the new boiler room at the south end of the yard. In other words, the coal storage is now central with respect to the two boiler rooms, and the independence of each is thoroughly insured.

In the plant of the Worcester (Mass.) Electric Light Company the advantages of the combination of old and new boilers in a single room appear plainly. The arrangement of the boiler and engine rooms in parallel instead of in tandem, as at Springfield's older plant, and the availability of space for lateral expansion at Worcester, indicated at each alteration of the plant within late years the propriety of keeping the entire boiler installation homogeneous and compact. With a hand-fired plant, as at Worcester, the importance of covering the maximum boiler horsepower with each man, up to the limit of first-class firing, renders it desirable to draw the installation close together. By proper valving of headers and supply pipes, precautions can be taken to insure continuous service, and if there is ample space for extension, using the walls of the original building and the steel or concrete structures of coal-handling equipment, reduced cost of additional boiler capacity will follow close upon the extension of the station.

INTERNAL-COMBUSTION ENGINES FOR ELECTRIC GENERATION.

One of the fields in which great progress has been made in the last few years is in the use of internal-combustion engines as prime movers for electric generation. The gas engine of today, whether utilizing natural gas, producer gas, or other fuel, represents an immense advance over its prototype, the original Otto gas engine.

In a recent address before the Blue Room Engineering Society, of New York city, Mr. George Orrok, secretary of the Gas Power Section of the American Society of Mechanical Engineers, and mechanical engineer of the New York Edison Company, stated that gas engines now show performances, under regular commercial conditions of running, of 20,000 down to 15,000 B. t. u. per kilowatt-hour, as compared with the best performance of the steam engine, namely, 25,000 or 30,000 B. t. u. The steam figures given were taken with oil as the fuel burned under the boilers, and are markedly superior to those for coal. Oil as fuel under steam boilers is used more extensively in the West, while coal fires are usually employed in the East.

Operating engineers in charge of steam plants of any capacity should give the necessary time and mental effort to the study of the gas engine—in fact, to the study of the whole subject of gas power, from producer or blast-furnace sources of gases, to ignition. The high-power gas engine has come to stay, after a long period during which its theoretical advantages as a prime mover—due to the elimination of one step in the energy-transformation cycle, by burning the fuel directly in the engine cylinder—seemed unable to attract the serious attention of investors. Among the opportunities for study of this subject we may mention the recently established Gas Power Section of the American Society of Mechanical Engineers. The new class of membership in this Section, known as the Affiliate, is open to operating engineers, who might otherwise hesitate to join the society. To become an affiliate means getting in touch with the great and increasing work of the society along the lines of this important subject.

In the early days of the experimental use of the gas engine in generating alternating current, much difficulty was experienced, and even more fear of difficulty was entertained, in establishing and maintaining synchronism between generators driven by gas engines and those driven by reciprocating steam engines or steam turbines. The basis of this trouble was that the early gas engines were of the "four-cycle" type, giving only a single power impulse per cylinder, for every two revolutions. This infrequency of the power impulses gave rise to some unsteadiness of operation, or rather to a variation of velocity in each revolution, which meant a corresponding variation of frequency in the alternating current generated. With the modern gas engine of the two-cycle type, used for electric generation, however, twice the number of power impulses per cylinder is obtained; and even with the four-cycle engine having two cylinders, the necessary steadiness of operation and uniformity of frequency is attained. With

this type there is no difficulty in securing a turning movement as even as that obtainable with good types of reciprocating steam engines. After all, good synchronizing in the central station, under modern conditions, is a matter of the skill of the attendant rather than of the type of apparatus.

In regard to the size of units, 5,600 horsepower is about the largest up to this writing, there being some six units of about this capacity in daily use. Two of the large gas-engine manufacturers have had orders for 240 1,000-horsepower cylinders—figures sufficiently striking to indicate the live status of the gas-engine proposition.

Gas engines are, it is true, relatively costly in space occupied. But, on the other hand, properly they are not to be installed where space considerations are extreme, as in plants located on expensive real estate in large cities. That is the field of the steam turbine.

In conclusion, the Siemens gas producer is the basis of this mighty advance. But blast-furnace gases and natural gas—and in the smaller sizes gasolene, denatured alcohol, and other fuels—are also distinctly of the present and future for the generation of power in internal-combustion engines. An interesting economy figure cited by Mr. Orrok was something better than a pound of coal per horsepower, on a year's run, using a suction producer and anthracite coal.

IMPROVED CONDITIONS IN THE UNITED STATES PATENT OFFICE.

The annual report of the Commissioner of Patents for the year 1908, as abstracted on another page of this issue, discloses an improved condition of affairs in the United States Patent Office that will be gratifying to the inventors, for whom the office is in existence. It has been a chronic complaint against this government bureau that it was woefully dilatory in its work and far behind the times in its general business methods. The adherents of the bureau have asserted that this was due to the failure by Congress to grant additional help for many years to keep pace with the steadily growing business of the office. During the past year Congress has yielded to these demands and given the office nearly one hundred additional examiners and clerks as well as provided an increase in salaries of the examiners for the first time in sixty years. This action of Congress and of Secretary of the Interior Garfield in bringing about the much-needed reforms has enabled the Patent Office to bring practically all its work close up to date within six months after the increased force set to work. A new classification division has been inaugurated that will properly classify and digest the millions of foreign and domestic patents issued, so that the labor and expense of future examinations will be much reduced and the degree of validity of the patents issued decidedly increased. While these reforms will undoubtedly have a prolonged influence in facilitating the work of the office, there should be made a more persistent endeavor to impress upon Congress from time to time the necessity of keeping the Patent Office closely in touch with the needs of the mechanical industries. The Patent Office is a more than self-supporting government bureau. There is on hand in the Treasury of the United States $6,890,726, which is the accumulation of the annual surpluses to the credit of this bureau. It has been strongly urged and should be insisted on that this sum, or as much thereof as is needed, should be used in providing a modern building that will adequately afford room for the prompt and proper conduct of the business of the inventors, for which they more than pay the total cost.

LIGHTING LARGE ENGINE ROOMS.

One of the most troublesome of the minor problems of power-plant design is the question of providing adequate lighting in the engine room without undue expense of installation and operation. The larger the station the more difficult it becomes to select the equipment best adapted to give plenty of light at moderate cost, especially when the head room in the station runs from thirty feet upward. The frequent solution is to install rows of incandescent lamps wired in multiple on the under sides of the steel roof trusses, supplementing this equipment with side lights on the walls and outlets for fixed or portable lamps at accessible points on the engine frames. In cases where the trusses are fairly low this method gives excellent results, provided a shade or reflector is used with each lamp to throw the light downward upon the machinery, and to prevent the dispersion of the rays horizontally where they can do little or no good. With the higher ceilings the individual lamps must be of greater power or spaced closer together in order to be effective.

In one plant recently examined the difficulties of proper lighting by the use of small units without reflectors were readily apparent when the conditions were considered. The engine room was ninety feet long by fifty feet wide, and contained three vertical cross-compound direct-connected units served by a hand-operated crane spanning the full width of the station. The bottoms of the roof trusses were thirty-five feet above the floor level. The lighting was accomplished by the installation of twenty-five ordinary clear-bulb sixteen-candlepower incandescents located about two feet apart on the under side of each truss, giving a total flux of 1,600 candlepower for the outfit. In addition the side walls were each equipped with three ornamental groups of three fifty-candlepower lamps each, and each engine was provided with twelve incandescents of sixteen candlepower, conveniently located and controlled by separate circuit switches. The excessive height of the engine room; absorbing power of the machinery, which was painted black; absence of reflectors above the truss incandescents; accumulation of dust on the relatively inaccessible bulbs; low individual power of the separate lamps, and the comparatively wide spacing of the bulbs in relation to the length and width of the room, combined to produce an illumination relatively expensive in first cost and maintenance, comparatively costly in current consumption, and insufficient in amount in the working portion of the plant. The side lights were not very effective on account of their small number and the absorption of the globes.

New Features of the Simplon Line.

BY C. L. DURAND.

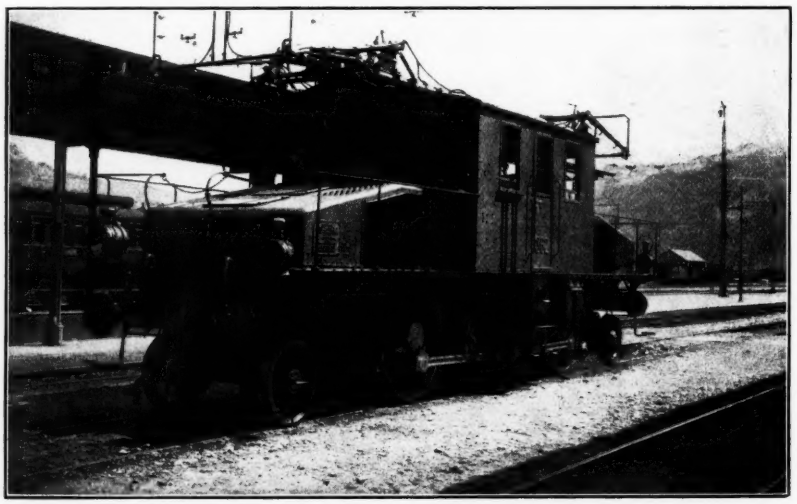
During a recent visit to Switzerland the writer spent some time in the neighborhood of the Simplon Tunnel, and was shown the most interesting features of this great enterprise by the courtesy of M. Graf, one of the chief engineers of the line. The present article will dwell especially upon the new points relating to the tunnel section, which have not been described hitherto, and at the same time give an account of the new Brown-Boveri electric locomotives which are now in use. These locomotives have been but recently constructed, and they present many points of novelty. It is claimed that they represent the latest advance which has been made on the Continent in the way of three-phase locomotives. Aside from the locomotives, the writer had occasion to inspect the two power plants of the Simplon section, one of which is located at the Swiss end of the tunnel at Brigue and the other at the Italian side at Iselle. At Brigue there is also a new station of considerable size, which has been installed in order to furnish the current needed for the lighting of the tunnel and of the station premises and also for the block signals as well as the signal lights within the tunnel. In order to secure the proper ventilation of the tunnel there is a set of powerful blast fans, driven by electric motors placed at each end of the tunnel. It will be seen, therefore, that the electrical features of the Simplon Tunnel section include a number of points which are worthy of mention.

It will be remembered that the tunnel, which is about twelve miles in length, is equipped with a 3,000-volt overhead trolley wire for the locomotives. There is an extensive station yard at the Brigue depot, in which there are a considerable number of tracks equipped with overhead wires. A like disposition, but on a smaller scale, is used on the Italian side of the tunnel, and here the available space is much less, owing to the mountainous character of the country.

Most of the electric equipment for the tunnel, the power stations and the locomotives has been installed by the Brown-Boveri firm, of Baden. After installing the Simplon line, this company engaged to operate it for a certain length of time in order to demonstrate the proper working of the system, after which the line was to be turned over to the Swiss Federal Railroads, should it prove satisfactory. This transfer was made during the past year, so that at present the Simplon section forms part of that system and is operated under the direction of the railroad department.

NEW THREE-PHASE LOCOMOTIVES.

As the new type of electric locomotive differs in many ways from what has been brought out up to the present in the way of three-phase locomotives for heavy trains, the writer will mention as many of the leading features as he was able to note during an examination of the locomotives. A complete technical account of the working of the motors and transformers and the remainder of the apparatus is now being prepared by the manufacturers.



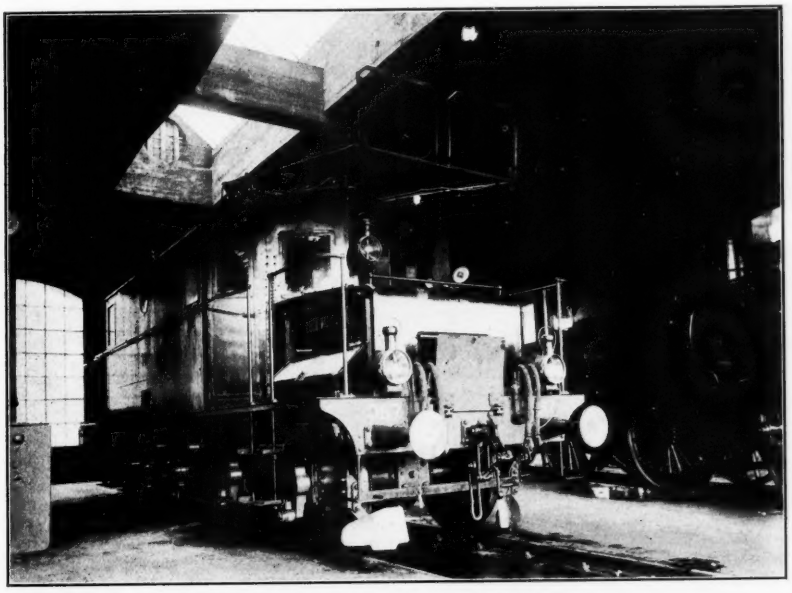
THE EARLY TYPE OF SIMPLON TUNNEL ELECTRIC LOCOMOTIVE.

The new locomotive has been in regular service upon the tunnel section for about six months past, and the engineers of the line consider that it shows a marked advance upon the former locomotives, which were constructed by the same company. At present the road is using two of the old locomotives and two of the new ones for taking the trains through the tunnel. As regards the former locomotives, a very complete description of them has appeared in a preceding issue of the ELECTRICAL REVIEW, so it will suffice merely to bring out the principal points of difference which are shown by the new type of electric locomotive.

As concerns the mechanical features of the locomotive, the main difference from the older type lies in the method which is adopted for driving the wheels from the motors. There are two motors on the locomotive, which occupy the whole width of the truck, and the wheels are driven symmetrically on either side. The two motors lie next the centre of the chassis and practically touch in the middle. In order to drive the wheels they are connected to the latter by a series of driving bars. In the previous type there were three main driving wheels used, and these were mounted together at the middle part of the locomotive. In addition to these there was a small pony wheel at each end, but only the three driving wheels were joined together by connecting rods. At the point where these are coupled to the middle wheel, there is joined a second and upper horizontal bar, which is also pivoted at this point. The ends of the upper bar are pivoted upon two cranks, which are mounted on the ends of the motor shafts. By this method of coupling, it will be seen that the rotation of the motor shafts is made to drive the upper bar and the middle wheel, and in consequence the connecting rods drive the other two main wheels at the same speed.

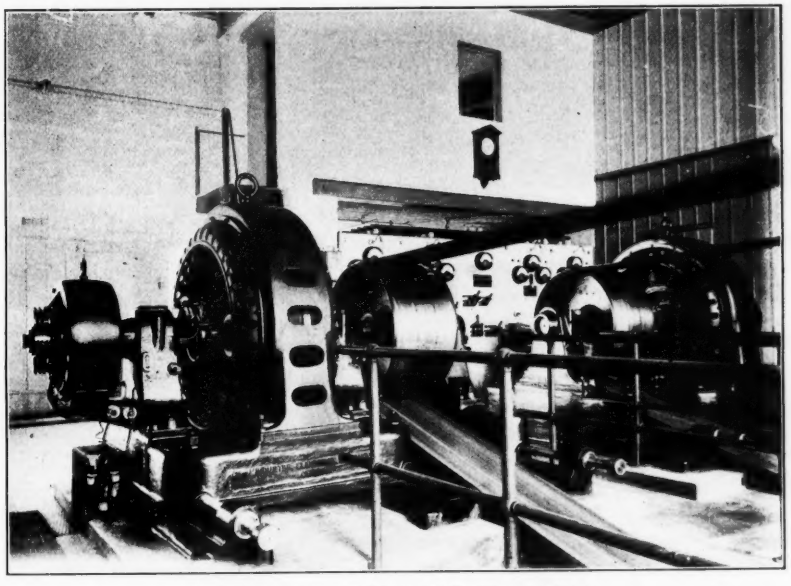
In the new locomotive the two motors are mounted on each side of the centre of the chassis, with the centres of the motors lying above the centre line of the locomotive wheels. On the shaft of

each motor is mounted a crank balanced by a counterweight, and each crank works upon a central driving frame, which is built as an X-shaped framework. From this there is a connecting rod passing to each set of the driving wheels of the locomotive, and it is connected to these by means of counterbalanced cranks. The disposition of the two sets of driving wheels is symmetrical. In this way the rotation of the motors is caused to drive the middle coupling frame, and thence the movement is transmitted to the locomotive driving wheels. This method is found in practice to be an advantage over the five-wheel system, which was used in the former type, and there are now four driving wheels on a side instead of three as before.



THE NEW SIMPLON TUNNEL LOCOMOTIVE.

In the electrical part of the new locomotive, one of the main points of difference lies in the construction of the motor. A new departure in the design of the motor lies in the use of a squirrel-cage rotor of large diameter, made up in the usual way, of a set of copper bars which are well ventilated. The bars are each connected to a common ring on the end of the rotor by means of end-coupling strips. Upon the end of the motor is bolted a spider of circular form, which serves as an end plate for holding the shaft bearing. In the new motor the design of the stator is such that the number of poles can be changed by means of a set of connections, which are brought to the controller, in order to secure some different speeds in this way. The former type of motor used a resistance in the circuit of the rotor, but the present type is superior in that it is not likely to burn out, and the rotor is of a simpler form. The motor, which is suspended from the side-bars of the locomotive, has a rated capacity of 650 horsepower and operates at 350 revolutions per minute when the train is running at the standard speed, or forty-five miles an hour. When at full speed it uses the voltage of the overhead wire, 3,000 volts, directly upon the terminals. This voltage is lowered by the transformer mounted on the locomotive when it is desired to reduce the speed.



THE SIMPLON TUNNEL LIGHTING PLANT.

These transformers are of large size and are mounted in the casings formed by the sloping ends of the locomotive. Each of the motors has one transformer allotted to it. The transformer has a number of separate windings, which have the ends brought out in order to give a certain number of different voltages upon the motor, and these connections are changed by means of a horizontal controller drum which is mounted along the outside of the transformer. The controller drum is rotated by means of a compressed-air device which is placed at one end, and turns the drum through a set of gearing.

All the apparatus of the locomotive is operated from the motorman's controller by a pneumatic system. For this purpose a motor-driven air compressor is placed just back of the transformer. The inside of the locomotive forms a roomy compartment, which contains the different controlling devices. At each end is the motorman's control bench, provided with a number of indicating instruments and the main controlling handle for the pneumatic devices. For changing the direction of the motors there is used a device which consists of a compressed-air motor to whose shaft is coupled on each side a contact drum for operating the reversing switch. Another pneumatic apparatus serves to change the number of poles of the motors in order to give different speeds. It is stated that by the use of the pole-changing method four speeds can

be obtained. In one case the use of six poles for the motor gives a running speed of forty-two miles an hour, and with double the number, or twelve poles, we have half the speed, or twenty-one miles an hour. For the second set of connections the number of poles is either eight or sixteen, and the corresponding speeds are thirty and fifteen miles an hour. At the same time, the speed can be changed by varying the voltage on the motor by changing the transformer connections. As regards the use of the transformer, it is the general practice to commence with 1,000 volts upon the motor from the transformer controller, and to gradually increase the voltage. The air compressor gives also the supply for the Westinghouse air brakes which the locomotive carries. All the pneumatic controlling devices within the cab are well protected, being housed within a series of casings in the wall. A very practical device is employed for preventing danger by touching the high-voltage apparatus. A key of special form is used for opening the doors of the cases, but this key acts as a plug for a contact device, so that by taking out the key from the socket the current is broken, and the doors cannot be opened before this is done. In this way none of the high-tension connections can be reached before the current is cut off.

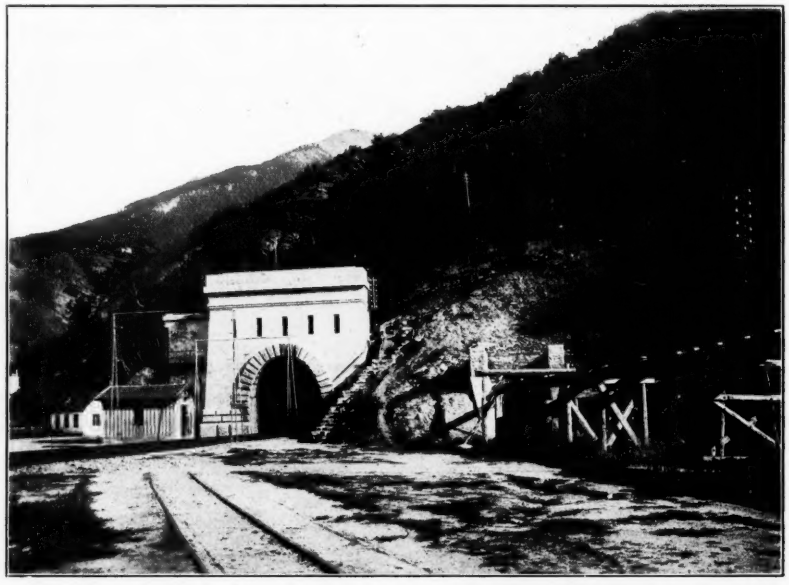
The lighting of the locomotive cab and also of the signal lamps on the ends of the locomotive is carried out by direct current, and for this purpose there is used a small motor-generator set which is run from the main transformer and delivers thirty-five volts direct current. As regards the trolley, which is mounted on the roof, the same kind of pneumatic trolley as was used before is retained in the present case, there being a device by which it is necessary to lower the trolley from contact with the overhead wire before the doors of the controlling apparatus can be opened.

At the present time there are in use two of the new locomotives and two of the preceding type. The trains are of variable length. The longest train which is used practically is made up of a locomotive and twenty cars. In the tests which were made some time since, it was found that the locomotives could draw a train of twenty-four cars. The maximum load drawn by a locomotive is 500 tons for a train of this kind, running in the tunnel at forty miles an hour, upon the gradient of 0.2 per cent and against the ventilating current of air which circulates within the tunnel. During the six months which they have been in service the new locomotives have made a total run of 25,000 miles, and their general performance, especially from an electrical standpoint, is considered as superior to the other type. There were also three of the Ganz Company's (Budapest) locomotives in use upon the Simplon line, but when the new ones were finished the others were transferred to the Valtellina railroad, in Italy, as they were needed for that line.

Counting both ways, there are now running about twenty-four trains per day on the tunnel section and thus passing between the Swiss Federal Railroad and the Italian railways. In this number there are many freight trains. As to the passenger trains, one of the principal ones is the train de luxe from Paris to Milan, which is generally made up of three cars.

As regards the maneuver of the trains, the operation is a very simple one. The train comes over the regular line of the Swiss Federal Railroads through the Rhone Valley, and reaches Brigue; it stops at the station, which is the terminus of the railroad line, and the steam locomotive is uncoupled and run upon a sidetrack. Passengers are not obliged to change cars, in the case of the through trains. One of the electric locomotives is then brought in front of the train and coupled to the latter. This operation does not usually take more than five minutes to carry out, and the train then proceeds for half a mile or more over the electric line, until it reaches the tunnel. It passes through the latter without stopping, and upon coming out of the tunnel it reaches the station of Iselle almost immediately, as the distance here is much shorter. At the station the electric locomotive is uncoupled and the steam locomotive, which is in readiness at this point, is coupled to the train. It then continues its way over the Italian railroad system by way of Domo d'Ossola to Milan and other points in the north of Italy.

It takes nearly twenty minutes to make the trip through the tunnel, even when the train is run at the high speed. It is noticed that the temperature rises considerably in the tunnel, and this is due to the presence of a number of hot springs, from which the water is carried off by piping. To keep down the heat, it was found necessary to establish a powerful draft through the tunnel, and for this purpose the present air-blast method was adopted. As before mentioned, the draft is obtained by the use of a ventilating plant at each end. In one of the illustrations, which shows the mouth of the tunnel at Brigue, will be seen a tower-like structure lying against the left-hand side of the portal. It contains a powerful suction fan which is driven by an electric motor in order to draw the air through the tunnel. At Iselle there is installed a similar blowing outfit, which is designed to aid the former, and in consequence it works in the contrary direction, forcing air into the tunnel, while the other fan draws it out. In order to



THE TUNNEL PORTAL, SHOWING TROLLEY SUSPENSION AT BRIGUE.

carry this out to the best advantage, the mouth of the tunnel is closed by a sliding gate when the train is not passing, and the air is drawn off by a side opening.

The arrangement of the sliding gate will be noticed in the same illustration. It is raised and lowered by an electric motor which is placed above the gate within the tunnel, by means of a chain-and-drum system. The gate is made of an iron frame, which is covered with stout canvas.

The power which is needed for operating the locomotives on the tunnel section is furnished by two different hydraulic plants, one of which is installed at Brigue and the second at Iselle, at the farther end of the tunnel. The second of these plants is designed to give 1,500 horsepower, while the first plant has a single unit of 1,200 horsepower, making a total of 2,700 horsepower available for the road. Waterpower is secured for the Brigue plant from a dam which is located at some distance up the Rhone Valley, and in this way there is secured a head of water of 140 feet.

The last-mentioned plant is used exclusively for the power supply of the road, and, besides this, there has been installed a large station alongside the former one, which serves for the lighting circuits. The latter includes the different lamps for the Brigue station and yards as well as the lighting of the inside of the tunnel. This station contains two principal units. The machines are driven by belt from a countershaft, and the turbines are connected to the latter. The alternators are of the three-phase type and are built by the Industrie Electrique Company, of Geneva; they run at 500 revolutions per minute and can develop twenty-five amperes at 4,000 volts. One of these units is sufficient to furnish the lighting current, and the second machine serves as a standby. At the end of the station is the main switchboard. The station also contains a small motor-generator set which is used for charging a storage battery, and the latter is employed for the current needed within the tunnel for the signals, bells and telephones. The generator set consists of a three-phase, 110-volt motor coupled to a 250-volt generator, and next to it is mounted a switchboard for these circuits.

A small room lying in the rear of the main switchboard is used for the connections of the back of the panels and also as a substation for the reduction of the voltage. This is carried out by two transformers which work on 4,000 volts for the primary and 110 volts for the secondary or lighting circuit.

Within the tunnel is a well-planned system of signals which are operated by the current from this plant on the storage-battery circuit. At each kilometre (0.6 mile) along the tunnel is placed an electric bell and a signal light, as well as a telephone. When the train is passing in the tunnel the lights are turned on, and the bell sounds at each of the odd kilometre points. Before the entry to the tunnel is a stationmaster's house, and at this point a bell is rung in order to show that a train has left the Brigue station and is approaching the tunnel. The signal lights, which are spaced along the tunnel, consist of a lantern placed along the wall and containing two incandescent lamps. These are supplied by a transformer for each lantern, which works on a voltage of 1,000, supplying 110 volts.

At the middle point of the tunnel there is an enlargement, which contains a double-track by-pass, in order to allow two trains to pass at this point should this be needed in any special case. Here is also located a room which contains various signal apparatus, especially that which is used for the block signals, and there is a storage battery installed at this point. The telephone which is placed at each of the kilometre points along the tunnel is used when any repairs or inspections are being carried out, so that the engineers or workmen can readily communicate with each other.

Laying the Cable Between Emden and Teneriffe.

Consul Solomon Berliner, of Teneriffe, Spain, referring to his report in June, 1907, regarding the concession granted to the German-Brazilian Cable Company to lay a cable between Emden, Germany, and Teneriffe, now advises that the work of laying it has begun. The first section, from Emden to Teneriffe, via Borkum, will have a length of 2,163 nautical miles. It has not yet been decided if the cable will then be laid direct from Teneriffe to Pernambuco, Brazil, or if it will be connected with Monrovia, Liberia. The length of the second section would be 2,766 miles in the first case, and 3,800 miles in the second, but the latter is considered more advantageous, as the cable, if connected with Monrovia, would serve the German colonies in Southwest Africa.

The Seventh International Chemical Congress.

A meeting of the joint organizing committee for the Seventh International Chemical Congress was held at the rooms of the Chemical Society in Burlington House, February 5, when a report by the honorary secretary of the progress made since the last meeting of the committee, was read and discussed. The following is an abstract of this report:

In response to a general appeal issued in December, about £4,400 has been received, and a sum of £187 has already been paid for membership fees.

The ambassadors, ministers and agents general of the leading civilized countries and of the British colonies have accepted the offices of honorary vice-president of the Congress, among them the following British ministers: Lord Morley, Lord Carrington, the Right Honorable R. B. Haldane, the Right Honorable J. Winston Churchill, the Right Honorable John Burns and the Right Honorable Reginald Mackenna.

The Lord Mayor of London and the chairman of the London County Council have also agreed to become honorary vice-presidents of the Congress.

Committees for promoting the success of this year's Congress have been formed in America, Austria, Belgium, Canada, Germany, Italy, Japan, Russia, Sweden and Switzerland, and in many other countries and colonies.

The Society of Chemical Industry has arranged to hold its annual meeting and luncheon in London on May 26, the day preceding that of the opening of the Congress; and the London section of this society has invited all those attending the Congress to an entertainment May 29.

The executive committee has drawn up a set of rules regarding the printing of papers for circulation among members before the actual meeting of the Congress, and copies of these rules have been sent to each sectional secretary and also to the foreign committees.

The foreign and colonial governments have been asked to appoint delegates to represent them at the Congress; these delegates will rank as honorary members. The leading scientific and technical societies have also been asked to appoint delegrates, who will rank as ordinary members of the Congress.

The address of the general secretary of the Congress is 10 Cromwell Crescent, South Kensington, London S. W.

THE ECONOMICAL DEVELOPMENT OF TOLL TERRITORY.—V.

(Concludcd.)

BY FRANK F. FOWLE.

INITIAL DEVELOPMENT.

Preliminary to building a toll plant a thorough inspection of the territory should be made and an estimate prepared covering the probable present and future development. Such an investigation makes possible the best engineering forecast as to the feasibility of developing the territory, including the capital required, the probable profits, the rates that must be charged, and the kind of service that can be offered. The order in which the various steps should be taken is as follows:

1. An inspection of each local system that will be served, noting the existing development, the rate of growth of population and development, and the preparation of an estimate of the cost of overhauling the plant so that efficient transmission will be obtained.

2. A subdivision of the entire toll territory into rate zones or districts so that every local telephone is definitely located within the confines of some particular zone.

3. A computation of the traffic to be expected between the two zones of every pair that can be named, based on the present local development and on the expected development at succeeding periods of five, ten, fifteen and twenty years.

4. The choice of locations for toll centres, the choice of the proper operating methods and a computation of the number of circuits necessary to handle the traffic at present and at succeeding periods as last named.

5. Based on a transmission standard which will be adequate when the twenty-year development has been reached, a calculation of the cost of the necessary plant to commence business and the cost of the subsequent additions to the plant from time to time.

6. An estimate of the plant charges and the minute-mile rate necessary to derive an equal revenue.

7. An estimate of the terminal charges so that by means of formula (1) the complete rate schedule can be worked out.

There will naturally be many possible layouts of pole lines and toll circuits which will supply a given service, but in general that layout is the best one which gives the highest miles of wire per mile of pole line for the whole system. The reason for this has already been made apparent in showing the effect of the miles of wire per mile of pole line upon the charges per mile of circuit per annum, and consequently upon the rates.

A high ratio of wire miles to pole miles in rural localities of sparse development will be obtained by making the greatest feasible use of existing pole lines, including exchange lines, farmer lines and such toll lines as may be in existence. In some cases a toll development may be possible only through the economies effected in this manner, making every use of existing poles and building only enough new pole line to span the gaps where no poles existed hitherto. There may be instances where it will pay to rebuild old lines, which have depreciated nearly 100 per cent, making the new line of adequate strength to sustain the extra toll circuits.

The spare capacity of a pole line at the time it is erected depends naturally upon the expected rate of development. In the rare cases where no future development is expected the full loading of a pole line when it is erected can be justified, but otherwise not. In no case, however, should the line be adequate to care for the future development at a period beyond the average life of the pole line; this statement is called forth by the fact that there are instances where this has not been observed, such, for example, as the erection of a thirty-five-foot line adequate for forty wires with an initial load of six wires. Every foot of unnecessary height in a pole line is a waste of capital and therefore an extravagance. It ought to go without saying that the spare capacity of a pole line should be adequate only to care for the development within the life of the line; equally the line should be no higher than the conditions require.

The following example is given in illustration of the method of computing the minute-mile rate. On the twenty-five-foot ten-wire line the annual charges per circuit mile on an air-line basis were computed to be $37.75. Under a rate system, uniform throughout the hours of the day, the ratio of the average week day (Monday to Friday) traffic to the total traffic for a month is 0.0376. Consequently each circuit-mile must earn $3.146 per month, or $.1183 per week day. Taking average circuit loads of twenty messages per day, each of four and one-half minutes' duration, the minute-mile rate is determined to be $.00131. The rate for a three-minute conversation on a haul of 100 miles, allowing $.25 to cover terminal charges, would be $.65 plus $.15 for each additional minute. The rate on a 200-mile haul would be $1.05 plus $.25 for each additional minute.

A large degree of economy in a moderately developed toll system is possible by the use of phantom circuits and the average annual charges per circuit-mile on a twenty-wire line can be decreased about twenty-five per cent if full use can be made of four phantom circuits. It is difficult in small systems to make efficient use of phantoms because of the difficulties encountered in ringing through several sets of phantom coils. The two physical circuits composing a phantom are unsuited for way-toll circuits with bridged or looping stations. The most efficient use of phantoms is possible when at least three direct circuits are required between a pair of offices, two of which are physicals and compose a phantom for the third. The addition of phantom coils to a physical circuit somewhat impairs its transmission efficiency, and due account must always be taken of this fact in considering the advantages of phantoms; the transmission over the phantom is slightly better than over the physicals. The physicals composing a phantom should be identical circuits as to gauge and kind of wire and pin separation; they should be adjacent circuits on the same cross-arm.

There is no choice between copper and iron for long-haul circuits; copper is imperative. But as regards short-haul circuits, there is something more to be said. There is no great difference in annual charges, but a considerable difference in first costs, iron being the cheaper. The annual charges are not greatly different for the reason that the low depreciation and high capital charges on copper are about equal to the low capital charges and high depreciation on iron. Consequently a given amount of short-haul service can be furnished with iron wire for a smaller investment than it could be furnished with copper. The risk to capital from possible failure of the enterprise may therefore be regarded as least when iron wire is used. On the other hand, it should not be overlooked that the low depreciation on copper is due not only to long life but to high junk value. There have been instances of the purchase of copper wire and its use for a number of years, after which it would have been possible to take it down and sell it at a net profit. This has been possible because of the purchase at prices below the normal market with subsequent

1. From a paper read before the International Independent Telephone Association, Chicago, Ill., December 1, 1908.

rise to normal, or the purchase at normal with subsequent rise to abnormal prices. The great electrical development of the country is almost certain to make junk copper wire a valuable asset for many years to come, or possibly for an indefinite period. This discounts to some extent the apparent reduction of capital risk by the use of iron.

FUTURE DEVELOPMENT.

The cost of erecting the physical plant necessary to offer a stated amount of toll service has been shown to depend fundamentally upon the three following quantities:

1. The standard of transmission.
2. The circuit loads.
3. The miles of wire per mile of pole line.

As the system develops there will be necessarily some decrease in the transmission efficiency, but there should be an increase both in the circuit loads and the miles of wire per mile of pole line. Coordinately there should be a reduction in the rates and some improvement in the speed of service. The circuit loads and the speed of service bear to each other an inverse ratio and consequently an attempt to improve the service unduly will result in a decrease of the circuit loads; reference to Fig. 5 will make this clear. It is reasonable to give the public better service as the business enlarges, but the improvement should not wholly cancel the increase in circuit loads which otherwise would result, unless the public demands faster service in preference to a reduction of rates. It can hardly be over-emphasized that the faster the service the higher must be the rates, for a fixed percentage of net profit, and this principle should be given a large amount of publicity because it is not believed to be generally understood by the public.

The development study should be revised and extended every few years, so that the forecast for the immediate future may be as accurate always as possible. Many improvements in the plant will be possible as the business develops, such as the shortening of original routes, the substitution of copper wire for iron, and the development of new routes paralleling old ones for the purpose of reducing the liability of service interruptions from the failure of any one route. There may, from time to time, be improvements, in the art of which advantage should be taken. Such improvements do not always make their appearance at a time when they can replace a plant which has depreciated 100 per cent. The saving which such improvements effect must more than offset the undepreciated value of the discarded plant if the adoption of the improvements is justified.

The trend which the development of the business should take has already been indicated, but a knowledge of the variation in the following quantities from month to month and year to year is necessary to determine the actual course the development is taking and to discover the general cause for any wrong tendency.

1. The total investment per mile of pole line.
2. The total investment per mile of wire.
3. The miles of wire per mile of pole line.
4. The average revenue per message.
5. The average haul.
6. The average duration of conversation.
7. The average receipts per minute-mile.
8. The average circuit load per day.
9. The average speed of service.
10. The average terminal charges per message.
11. The average receipts per wire-mile per annum from message service.
12. The average receipts per wire-mile per annum from private-line and leased-wire service.
13. The ratio of total operating expenses to total revenue.
14. The ratio of total annual revenue to the average total investment during the year.

This list appears at first sight rather formidable, but in reality it depends only upon the most fundamental statistics of the business, without a knowledge of which there can hardly be an intelligent understanding of the changes that are taking place constantly and must be tending in the main toward either increased or reduced profits.

COMPETITIVE TERRITORY.

The subject has been treated hitherto entirely on a non-competitive basis, so far as competition affects the predetermination of traffic. Competition in public service is a much-discussed and unsettled subject, so far as telephone service is concerned. The writer holds the view that competition is justifiable in every case that a public necessity for it can be shown. Upon this view the argument would hinge upon what constitutes a public necessity. The fault of many public service companies which were early engaged in the telephone business lay in their failure to develop, their failure to recognize that a high-priced exclusive service, only within reach of the means of the few, was not public service.

It is offered as fundamental that the measure of efficiency in public service in any given district is the ratio of the number of the public service company's patrons to the total population. Among the foremost obligations of a public service company is that of developing its territory to the greatest possible extent. This implies that good transmission, accurate service and fast service must be given at the lowest rates consistent with the principle of cost plus a fair profit on the investment. In toll service the situation as regards competition is not identical with the case of local service, and the discussion which follows is intended to apply to the former entirely.

Poor service in any one of several forms, high rates and underdevelopment are the basis of a just demand for competition. The investor is concerned first with whether the demand can be supplied on a profitable basis. There are, from the standpoint of safe investment, far greater risks in competitive than in non-competitive territory, due to the possibility of rate wars and profit cutting. There is a very slim margin to meet such contingencies in a business that is operated upon the principle of cost plus a fair return on the investment. Every unprofitable investment hurts the business as a whole, because it usually receives much more prominent notice than the many successful investments, and consequently disturbs the confidence of the investor.

The point upon which the writer would place special emphasis is the necessity of applying the whole development study, which is the subject of the paper, to competitive territory with even greater care and thoroughness than would be used with non-competitive territory. Two toll systems side by side, serving the same territory under like conditions, whether they connect with the same or competing local systems, cannot furnish service of the quality and at the rates possible with a single system, until one of the two systems secures nearly all of the business, or there is so much business that both systems may approach a large development. The duplication of pole lines everywhere throughout a territory means necessarily a smaller number of miles of wire per mile of pole line than in the case of one system furnishing the same amount of service. But it is also true that, on

the other hand, the public will enjoy whatever improvement in service and rates the new competitor is able to offer, and to that extent the conditions previously existing will have been improved, although the ideal service may not be closely approached. In the event that the old company is awakened to a sense of its public obligations when at last its business is threatened, or perhaps reduced to an embarrassing extent, it may improve its service and reduce its rates sufficiently to win back some of the business transferred to the new competitor and leave the latter in the position of having performed a valuable public service without deriving the expected profit. To the end that this may not happen, it will be a matter of business prudence to secure, in advance, long-term contracts of such a nature that the plant with which business is commenced shall have continuously a traffic load that will make the investment profitable. Any other course necessarily casts the whole venture into the speculative class, owing to the uncertainty as to the future course of the old company, except when that company is financially unable to make improvements. It has not been the purpose here to attempt a definite treatment of the question of competition versus monopoly—that is believed to be properly regulated by the matter of necessity—but to point out the conditions which make competition desirable and some of the results which competition may bring about.

Proposed Indiana Public-Utility Legislation.

In addition to a general-utilities bill there are several measures pending before the Indiana Legislature that are giving traction and electric-light men much concern. One bill seeks to compel interurban companies to separate grades at highway crossings, another provides that only half-fare can be collected from a passenger who is not provided with a seat. A third bill provides for a fare of not more than one-and-one-half cents a mile for all interurban lines, and prevents the traction companies from establishing arbitrary fare zones. The bill providing that passengers who are obliged to stand shall be carried for half-fare, has gone to engrossment and may become a law.

One bill requires that applications for franchises for electric lighting or other utilities shall, on petition of twenty-five per cent of the voters, be voted upon by them, and shall not be granted if an adverse decision is reached. S.

The Wright Aeroplane and Wireless Telegraphy.

The meeting of the Chicago Electric Club in the grill room of the Automobile Club, Wednesday noon, February 10, was addressed by Frank L. Perry on the subject of "The Wright Aeroplane and Its Possible Use as a Basis for Wireless Telegraphy." Mr. Perry spent a month at Fort Meyer during the government trials of the Wright aeroplane in September, as the representative of the WESTERN ELECTRICIAN. During this time he was in close contact with the aviator and members of the Signal Corps and other government officials interested in aerial navigation.

Mr. Perry had constructed in his laboratory, with considerable ingenuity and fidelity, a model of the Wright aeroplane, complete in every essential detail. The planes of this miniature airship measured about a yard in extent, and were arranged, by means of cords, to be warped exactly as in the case of the larger craft. This model was brought into the room dismantled, so that while the speaker was engaged in assembling the craft he was afforded an opportunity to explain the construction and uses of the parts. As the result of Mr. Perry's personal contact with the aviator, Orville Wright, during the period of the government tests at Fort Myer, he was enabled to present a large amount of first-hand data, as well as to evolve for the benefit of the engineers present, several of his own deductions as to how the airship really flies, has its equilibrium maintained and is steered. These points, which have been discussed often with little intelligence by the lay newspaper reporters, provided interesting topics for Mr. Perry's explanation. It is Mr. Perry's belief that the equilibrium of the Wright aeroplane is maintained essentially by the deflection of the planes, an action which has often been ascribed to cause the guiding of the craft. Mr. Perry thinks that the matter of steering is almost entirely the function of the rudders.

In order to explain the possible use of the aeroplane as a basis for the transmission of wireless messages during scouting maneuvers, Mr. Perry explained the division of the structure of the craft into two either vertical or horizontal wings, thus providing in effect the plates of a Hertzian oscillator. By the use of wires strung over the planes, providing the upper antennæ, linked through a spark-gap to the suspended anchor wire, which constituted the other member of the oscillator, Mr. Perry depicted a possible arrangement of the wireless-telegraph equipment, supplying his miniature sending apparatus from a battery coil.

This talk before the Electric Club was one of unusual interest. When the speaker had rapidly run through the points which his limited time permitted him to discuss, he was asked to answer a great many questions from the electrical men present. Mr. Perry also exhibited a model of the starting apparatus, comprising the derrick, weight and track, used by the Wright brothers in beginning the flights of their aeroplanes.

Following the talk, President C. A. S. Howlett of the Electric Club announced the appointment of the chairmen of committees as follows: Speakers committee, F. S. Hickok; finance committee, S. F. Dibble; entertainment committee, J. J. Schayer; membership committee, H. F. Holland; house and reception committee, W. R. Pinckard.

American Society of Hungarian Engineers.

A number of Hungarian engineers and architects pursuing their professions in this country, have organized the "American Society of Hungarian Engineers and Architects." The society has two objects: First, to bring into closer touch engineers and architects of Hungarian extraction living in this country, and to give moral support and information to newcomers; second, to encourage the exchange of engineering, technical and industrial information between the technical men of Hungary and of the United States, and to foster technical societies, sciences and industries.

The society will hold monthly meetings, where papers will be read and discussed. The membership consists of mechanical, electrical and civil engineers, chemists, architects and craftsmen. Following are the officers of the new society: President, A. Henry Pikler, M. E., Member A. I. E. E., engineer in charge of transformer department, Crocker-Wheeler Company, Ampere, N. J.; vice-president, Karoly Z. Horvay, Architect, Board of Education, Brooklyn, N. Y.; secretary, Zoltan de Nemeth, M. E., New York Edison Company; treasurer, Sandor Oesterreicher, E. E., associate member A. I. E. E. and A. S. M. E., New York Edison Company. The society's business address is Box No. 1031, New York city.

SOLID RECTIFIERS.

BY GREENLEAF W. PICKARD.

In 1874 Ferdinand Braun published an account[1] of his investigations of the assymmetric or unilateral conduction of current by certain of the natural (mineral) metal sulphides. Although this publication is undoubtedly the first important contribution to our knowledge of this subject, Braun's methods of observation, as will be hereinafter shown, were such that concordant results were not obtained, and in consequence a false theory of the phenomenon, based on crystalline structure, resulted.

Braun's principal tests were made upon the mineral tetrahedrite, a compound of copper, antimony and sulphur, having essentially the formula $Cu_6Sb_2S_7$, but with material amounts of other metals replacing a portion of the copper. Tetrahedrite, considered from the crystallographic standpoint, is in the isometric system, and, as is suggested by its name, crystallizes in the tetrahedral group, forming well-defined tetrahedral crystals. It was with such crystals that his principal tests were made, in which the most marked assymmetry was found. The method employed was to include the mineral in circuit with a potentiometer and galvanometer by means of two silver wires with rounded ends pressed firmly in contact with the crystal, and to note the change of galvanometer deflection upon reversal of the current. With the above arrangement, Braun found that certain pairs of contacts gave deflections depending upon the direction of current flow, the ratio of the apparent conductivities corresponding to these deflections being in one experiment as great as seven to twenty. The maximum ratio between positive and negative current conductivities was found when one wire contacted with the base of the tetrahedron, while the other pressed against one of the plane faces near a point of the crystal.

Braun's tentative theory of the action, advanced in the above-mentioned publication, was based upon a supposed thermal expansion of portions of the crystalline structure by the current, this expansion acting in one direction to increase the effective area or number of minute contacting points of one of the metal electrodes with the mineral, and in the other to decrease this contact area. His explanation of the mechanism of this supposed action is by no means clear, being based upon a unilateral heating and cooling (apparently a sort of Peltier effect) of the base and point of each of the minute tetrahedrons comprising the entire crystal. As I shall hereinafter show that whatever may be the true explanation of unilateral conductivity, crystalline structure does not necessarily enter as a factor, it will be unnecessary to consider this hypothesis in further detail.

Braun, however, effectively disposed of any thermoelectric explanation of the phenomenon. In the above-mentioned experiment with tetrahedrite, electromotive forces of as high as eight Bunsen cells (approximately fifteen volts) were employed. While it has been known for a long time that the thermoelectric powers of certain minerals, particularly some of the metal sulphides, were much higher than those of the metals, certain mineral thermo-couples giving ten or fifteen times the electromotive force per degree of the most powerful metal-to-metal couple, yet even this high thermoelectric power falls far short of explaining a marked unilateral conductivity under electromotive forces as high as fifteen volts. While thermoelectric action must be abandoned as explaining this phenomenon, there is, however, a significant relation between high thermoelectric power and unilateral conductivity, which will be considered later.

In answer to certain criticism of the above-mentioned article, Braun, in a later publication, defends his explanation, and gives further reasons for considering the effect as distinct from either thermoelectric or imperfect contact action. In this reply[2] he describes in detail his test of another unilateral conductor, psilomelane, a hydrous oxide of manganese.

The employment of unilateral conductivity for the purpose of rectifying alternating or oscillating currents was not considered by Braun, nor, indeed, does it appear that anyone conceived of the possibility of this until after wireless telegraphy had been in use for a long period of years.

The later investigators who have repeated this work of Braun, notably Pierce[3] and Fleming[4], have considered the possibility of the use of unilateral conductivity as a means of rectification either of alternating or oscillating currents, but with this exception have added little of novelty to the early publications of Braun. It is true that with the greater instrumental equipment available, these experimenters have made far more accurate measurements, and, by extending the range of the investigation, the list of unilateral conductors has been quite materially increased. Little, however, seems to have been accomplished toward the establishment of the conditions of contact necessary to make this phenomenon a definite one as to direction and amount, and the influence of Braun's incorrect crystalline-structure theory of the action has persisted to the present time, as is particularly shown by the title of the above-mentioned publication of Pierce, "Crystal Rectifiers," and by the hypothesis advanced by Fleming, in which the crystalline structure of the unilateral conductor is considered as an electronic valve whose complex molecule allows electrons to leave more freely at some points on its surface and to take them in more freely at others. Fleming states that if these molecules are irregularly arranged, the electrons should be able to move with the same ease in either direction, but considers that if the substance be crystallized, it is possible that all the valves might face one way, thereby facilitating the electron drift in one direction, while offering great opposition to their motion in the opposite direction.

This explanation, while undoubtedly ingenious, certainly more plausible than that of Braun, and in probable accord with the facts as known to Fleming, would hardly have been advanced had he been in possession of complete data as to the conditions governing this action.

The writer's attention was directed to the phenomena of unilateral conductivity some years ago, while investigating the action of a certain type of telephone transmitter. In this instrument, known as the Blake transmitter, a platinum bead is pressed in contact with a polished carbon surface, and a small electromotive force (a single cell of Leclanche battery) is included in a local circuit through this contact. In the normal operation of this transmitter, the platinum bead is in light or microphonic contact with the polished carbon surface, and the local current exhibits the customary irregularities of current flow through imperfect contacts. In an attempt to obtain constant conditions, the writer increased the pressure to such an extent that the contact became sub-

1. "On the Conduction of a Current Through Sulpho-Metals." Poggendorff's Annalen, Vol. 153, 1874, p. 556.

2. Annalen der Physik und Chemie, Vol. 19, 1883, pp. 340-352.

3. Physical Review, June, 1907.

4. Cassier's Magazine, Vol. 34, September, 1908, pp. 458-464.

stantially perfect, although still of extremely small area. An accidental reversal of the battery, in a repetition of a series of resistance measurements, disclosed the fact that the transmitter was now unilaterally conducting, although but feebly, the current in one direction being about five per cent greater than that in the other.

The possibility that this action might be the basis of an efficient "wireless" detector, particularly for wireless telephony, was thereafter conceived, and this observation became the starting point of an extended investigation of the action of contacts of small area between dissimilar conductors, resulting in the discovery of a very large number of unilateral conductors capable of forming efficient wireless detectors under certain conditions of structure.

Early in this investigation was discovered the necessity of establishing for the second circuit terminal of the unilateral conductor, a contact not only substantially perfect, but of large area. In the lack of such a contact of large area, the rectification obtained was not only variable as to direction, but was frequently entirely absent, owing to an opposing action at the second contact, which, if of small area, itself acted as an opposing rectifier, thereby reducing or even eliminating the observable rectifying action. Braun, working with two contacts of small area, obtained accidental unilateral conductivity, which was doubtless due to differences in the physical character of the contact surfaces, whereby one contact was occasionally of larger effective area than the other. For example, in his two contacts on the crystal of tetrahedrite, the one on the base, and the other on one of the planes near a point, the former was probably a fracture face made in removing the crystal from its surrounding mineral. This contact might occasionally be of different effective area than the contact on a smooth, even, mirror-like, crystal face, even although the contacting terminals were similarly shaped, and applied with equal pressure. Had Braun employed the method early adopted by the writer to insure contact of large area, which consists in mounting the rectifying conductor in fusible metal, his results would have been of a far more definite character. And not only would they have become definite, but a few tests would have demonstrated that the direction of rectification was always the same for the same conductor, regardless of the position of the contact of small area with respect to the crystal faces or structure. This is clearly shown by the following experiment, which can be made with any asymmetric conductor. The conductor is first shaped into a rough cube, and one of its faces pressed into molten fusible metal, which is allowed to cool and solidify, thereby securing a perfect contact of large area. The remaining five edges of the cube can then be explored with an electrode of small area, with the invariable result that the rectification observed is always in one direction. For example, a crystal of the well-known electric-furnace product, carborundum, or carbon silicide, always acts as an "in" rectifier, the maximum conductivity being for currents entering the crystal through the contact of small area, and the minimum being found for those in the opposite direction, entering through the contact of large area, and leaving through the smaller. For the above reasons, the writer calls the combination of a unilateral conductor with a large and a small-area contact a solid rectifier, in distinction from the well-known electrolytic and gaseous rectifiers.

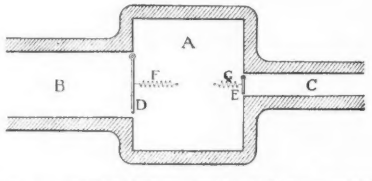


FIG. 1.—HYDRAULIC ANALOGY OF SOLID-RECTIFIER ACTION.

Although no better proof is needed of the independence of the rectifying action and any crystal structure than the simple fact above stated, *i. e.*, the independence of crystal structure and position of the small-area contact, it may be of interest to state that the writer has discovered a number of amorphous rectifying conductors. Among these are varieties of the non-metallic element silicon, and solid solutions of certain metallic oxides (notably zinc oxide), in readily fusible silicates. Optical and other tests have shown the entire absence of regular crystalline structure in these conductors, yet they possess marked rectifying properties, the rectification being always in the same direction for the same conductor.

A clearer conception of the rectifier action may be obtained by considering a hydraulic analogy of the solid rectifier which has been developed by the writer. In Fig. 1 the rectifying solid is represented by a closed vessel A fitted with large and small outlet and inlet pipes B and C, which represent, respectively, the large and small circuit contacts of the rectifying solid. In the vessel A, at the openings of the pipes B and C, are placed swinging valves, D and E. These valves are shown as leaky valves, not completely fitting their respective orifices, the cross-section of the leak around the valve being perhaps ten per cent of the entire cross-section of the orifice in each case. This leak represents the incompleteness of the valve action in the solid rectifier, which does not entirely stop the reverse flow of current. Attached to the valves D and E are retractile springs F and G, which tend to make the valves resist any outward flow of water. It is apparent that a flow of water through the pipe C into the vessel A will not be resisted by the valve E, and as the leak around valve D may be of larger area than the total cross-section of the orifice of pipe C, any amount of water that can enter A through C can leave it by means of this leak, without disturbing valve D, which, though held against a flow outward from A, is powerless to check the small flow that can enter through C. If it is attempted to pass a current of water through the vessel A in the reverse direction, from B to C, valve D and its large leak will offer no opposition, but valve E, with its retractile spring G, opposes effectively all flow save that minute one due to its own leak. If, now, the above device is connected between two water mains which are alternately supplied with pressure, representing the terminals of a circuit across which there is an alternating electromotive force, a rectified current will flow through the vessel A, as a pulsating direct current from C across to B.

While the above analogy is by no means perfect, it is probably as good as the average hydraulic analogy of an electrical action. It illustrates clearly the effect of the large and small contacts in the solid rectifier, particularly as to the indifference of the large contact to the currents rectified by the smaller. It should be clearly borne in mind, however, that in all probability no such structure as shown actually exists in the solid rectifier.

Among the many solid rectifiers discovered by the writer, there are three which have proved of commercial value in wireless communication. These are the silicon[5], perikon[6] and molybdenite[7] detectors,

5. United States Patent Nos. 836,531, 877,451, 888,191.
6. United States Patent No. 886,154 and Trademark No. 70,587.
7. United States Patent No. 904,222.

constructed, respectively from the unilateral conductors silicon, zinc oxide and molybdenum sulphide. Although these all act as rectifiers, they are not equally efficient as wireless detectors, the best being the zinc oxide or perikon detector.

In Fig. 2 are shown the characteristic voltage-conductance curves of these three detectors, when in their most sensitive state as wireless detectors. These curves were obtained by placing the detector in a wireless receiving circuit, adjusting until the maximum response was obtained to a distant sending station, and then interpolating a galvanometer, potentiometer, battery and reversing switch in the detector circuit. By varying the magnitude and direction of the electromotive force over a wide range, the relation between voltage and current was obtained, and from this the apparent conductance determined. The rectifying conductors were in all cases set in fusible metal, to insure a perfect contact of large area for the non-rectifying terminal, while the contact of small area, or rectifying terminal, consisted of a rounded brass point on both silicon and molybdenite, and a fragment of chalcopyrite, or copper-iron sulphide, for the perikon or zinc-oxide detector.

By varying the adjustment, it was found possible to produce much higher ratios between the "in" and "out" conductances than those shown in the curves, but with such adjustments the efficiency as a wireless detector was found to be materially reduced, probably owing to the fact that the highest ratios were obtained by such minute effective contact areas that the resistance of the detector became too high for the maximum efficiency in the wireless circuit. It will be noted that the maximum slope, or change in conductance, is confined to a range of but a few tenths of a volt. The conductances are given in microhms, or reciprocal megohms; thus, for example, the conductance of the perikon detector at zero voltage is forty microhms, which corresponds to a resistance of 25,000 ohms, or one-fortieth megohm.

In the course of the writer's investigations it was discovered that in all solid-rectifier detectors investigated, the action is materially improved by the use of a small electromotive force in the detector circuit, this being so poled as to send current through the rectifier in the direction of the rectified current, its magnitude being such as to bring the conductance of the detector to the steepest part of the curve. For example, in the case of the perikon detector, the best electromotive force is about one-tenth volt, so poled as to cause a circuit flow into the rectifying conductor through the contact of small area. The curve for silicon indicates that with this detector the best electromotive force is about two-tenths volt, in the opposite direction to that employed with perikon, and this is closely checked by experiment.

The writer frankly confesses that he has no satisfactory explanation of the phenomena of rectification in solid conductors. In his early work he adopted the thermoelectric hypotheses for public explanation, not that it was satisfactory even then, but because it was at least understandable and fulfilled many of the conditions. Curiously enough, all of the rectifying conductors possess high thermoelectric power, as well as high specific resistance (at least in comparison with any of the metallic conductors) and high thermal conductivity. There is undoubtedly a connection between high specific resistance and thermoelectric power. Liebenow[8] gives the following formula for thermoelectric power:

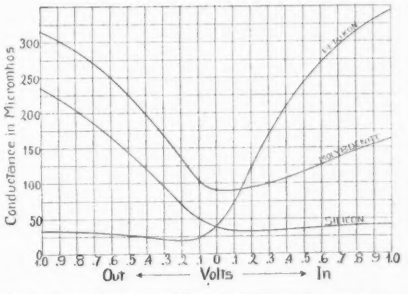


FIG. 2.—CHARACTERISTIC CURVES OF VARIOUS SOLID RECTIFIERS.

$$dE = \pm 2.04 \sqrt{\frac{RL}{T}}\, dt,$$

where E = electromotive force.
R = specific electrical resistance.
L = specific thermal conductiivty.
T = absolute temperature.

It is apparent from this formula that high thermoelectric powers would not be expected in metallic conductors, for the reason that in all metals low specific thermal conductivity is associated with high specific resistance, *i. e.*, thermal and electrical conductivities vary together. As above stated, all the rectifying conductors fulfill the conditions demanded by this formula for high thermoelectric power.

In the early rectifying conductors examined by the writer the thermoelectric currents were in the same direction as the rectified current. This seemed to support the thermoelectric theory of the action, but later a number of rectifying conductors, such as, for example, impure silicon, were found to have the thermoelectric current in the opposite direction to the rectified current, and when tested as detectors the resultant current was found to be in the reverse direction from that produced by heating the junction, thereby proving that the action could not be thermoelectric. Austin has independently, although later than the writer, discovered this opposition of thermoelectric and rectification action in the case of impure (commercial) silicon. It is a fact, however, that out of several hundred solid rectifiers investigated by the writer but three have been found with the thermoelectric action in opposition to the rectified current.

Although the writer has no entirely satisfactory theory of the action in a rectifying conductor, he advances the following:

As an extremely perfect contact of small area is one of the requisite conditions for the manifestation of the rectifying property, it is evident that the current flow in the rectifying conductor must be extremely constricted in the immediate neighborhood of this small contact. Such extreme constriction of current path in material where the conduction is not metallic may lead to electronic impoverishment of either the positive or negative electrons, according as the conductor is an "in" or "out" rectifier, thereby making the passage of either "in" or "out" currents difficult, the conductor and contact of small area then acting as a rectifier. The improvement noted when a small electromotive force of the proper amount and direction is employed in the detector circuit may perhaps be due to the further electronic impoverishment created by such a current.

Aside from their utility as wireless detectors, solid rectifiers afford the best means of measurement of extremely small alternating currents, such, for example, as those existing in wireless receiving circuits energized from very distant sources. The writer has found that with the perikon detector any received signal capable of giving an appreciable sound in the telephone receiver will give a measurable deflection of a galvanometer in the same circuit.

Owing to the fact that commercial wireless receiving circuits are rarely free from

8. Wiedemann's Annalen, Vol. 68, p. 316.

9. Bulletin of the Bureau of Standards, Vol. 5, August, 1908, pp. 133-147.

irregular, though minute, extraneous disturbances other than the currents under measurement, an extremely sensitive galvanometer is not always desirable. The writer uses for such measurements a 2,000-ohm D'Arsonval galvanometer, giving at one metre distance a millimetre scale deflection for 2×10^{-9} ampere. This not only gives measurable deflections on all signals of readable intensity, but may be readily calibrated on low-frequency (sixty-cycle) alternating current by the use of a potentiometer adapted to alternating currents.

For measurements on circuits free from such disturbances a much more sensitive galvanometer may be used. With this it is possible to measure received signals that are entirely inaudible in the most sensitive telephone receivers. It is also possible to do this on low-frequency circuits. In a series of measurements made by the writer on the attenuation of 750-cycle alternating current on artificial telephone circuits, measurements were found possible when a sensitive telephone receiver in series with the detector was absolutely silent.

Selective Emission of Incandescent Lamps.

The February meeting of the New York Section of the Illuminating Engineering Society was held on February 11 in the Engineering Societies Building, the small attendance being in a measure offset by the number of prominent men present.

A paper, entitled "Selective Emission of Incandescent Lamps as Determined by New Photometric Methods," by E. P. Hyde, F. E. Cady and G. W. Middlekauff, was read by the first named, and this abstruse subject was presented in such a manner as to be readily understood by all. That the subject is of great importance may be seen from the introduction presented by the authors, viz.:

"The recent development of high efficiency metallic - filament lamps has aroused new interest in the measurement of the high temperatures of glowing metals, and has raised the question as to whether the high efficiencies are due primarily to the high temperatures at which the filaments operate, or to a selective radiation, where by selective radiation is meant that the distribution of the energy in the spectrum of the radiating body at a given temperature is different from that of a black body at the same temperature."

The authors investigated seven kinds of filaments by the method which was first outlined by Holborn in his original description of the Holborn pyrometer, and which was subsequently applied by Drs. Waidner and Burgess in their recent work, "Preliminary Measurements on Temperature and Selective Radiation of Incandescent Lamps," and the results of the investigation are given in Tables I, II, and III.

TABLE I.—AVERAGE VALUES OBTAINED ON LAMPS OF EACH TYPE AT VOLTAGES CORRESPONDING TO A "COLOR MATCH" WITH THE STANDARD LAMP AT 75 VOLTS.

Types of Filament.	Red Black-Body Temperatures.	Relative Per Cent Change Cp. for 1% Change in Watts.	Lumens per Watt.
Untreated carbon.	1420 C.	1.00	1.00
Helion	1405	1.00	0.97
Treated carbon...	1395	0.97	1.06
Gem	1400	0.98	1.05
Tantalum	1340	0.83	1.28
Tungsten	1345	0.79	1.49
Osmium	1390	0.80	1.85

TABLE II.—AVERAGE VALUES OBTAINED ON LAMPS OF EACH TYPE AT VOLTAGES CORRESPONDING TO A "COLOR MATCH" WITH THE STANDARD LAMP AT 100 VOLTS.

Types of Filament.	Red Black-Body Temperatures.	Relative Per Cent Change Cp. for 1% Change in Watts.	Lumens per Watt.
Untreated carbon.	1680 C.	0.86	3.85
Helion	1650	0.85	3.85
Treated carbon...	1645	0.84	4.15
Gem	1650	0.84	4.0
Tantalum	1570	0.72	4.35
Tungsten	1555	0.71	5.25
Osmium	1610	0.69	5.9

TABLE III.—AVERAGE VALUES OBTAINED ON LAMPS OF EACH TYPE AT VOLTAGES CORRESPONDING TO A "COLOR MATCH" WITH THE STANDARD LAMP AT 125 VOLTS.

Types of Filament.	Red Black-Body Temperatures.	Relative Per Cent Change Cp. for 1% Change in Watts.	Lumens per Watt.
Untreated carbon.	1890 C.	0.76	9.0
Helion	1850	0.75	9.2
Treated carbon...	1855	0.74	9.5
Gem	1855	0.76	9.4
Tantalum	1765	0.65	10.0
Tungsten	1740	0.67	11.5
Osmium	1800	0.65	12.5

Thus, from the data given in column 4, it will be noted that when these various types of filaments have the same distribution of energy in the visible spectrum, the lumens per watt range from unity to 1.85.

If there were no relative selectivity, the lumens per watt would be unity for every type. There is marked evidence, therefore, that there is considerable selectivity among the different types of filaments, and it is quite interesting to note the order in which the filaments arrange themselves. A higher value of lumens per watt, as, for example, the value of 1.85 for the osmium lamp, as compared with 1.00 for the untreated carbon filament, indicates that when the osmium filament has the same distribution of energy in the visible spectrum as the untreated carbon filament, the energy curve of the osmium lamp drops off considerably in the infra-red as compared with the energy curve of the untreated carbon. In other words, the osmium radiates selectively in favor of shorter wave-lengths, that is, in favor of the visible spectrum, and is, therefore, a more efficient luminous radiator than an untreated carbon filament.

The authors have been unable to determine the true temperature at which a color match with a black body can be obtained with any material except platinum, and, therefore, they are unable to state as to what extent the higher efficiency of the metallic filaments is due to selective radiation, although the results would indicate that in the case of osmium from thirty to forty per cent of the increased efficiency over a carbon-filament lamp is due to selective radiation.

The paper was discussed by Professor Ganz, Dr. A. H. Elliott, Wilson S. Howell and P. S. Millar.

The Mexican Northern Power Company.

The Mexican Northern Power Company is a new Canadian enterprise recently organized with a capital stock of $10,000,000 and an authorized bond issue of $7,500,000. The company has secured valuable franchises from the government of Mexico for the utilization of water-powers in the northern portion of the Mexican Republic. The powers granted are very broad, embracing the use of water for irrigation purposes as well as for power and light. The franchises are perpetual in their tenure, and carry exemption from taxation for a term of years. Bonds amounting to $5,000,000, recently offered for subscription by the Canadian Electric Syndicate, of Montreal, have been largely over-subscribed. G. F. Greenwood, C. E., late managing director of the Havana Electric Power Company, is the president of the new concern; E. B. Greenshields, director of the Bank of Montreal, is vice-president, and Frank Thompson, secretary. The company expects to develop up to 30,000 horsepower, there being, it is stated, a market for more than twice this amount of power. The consulting engineer of the company is W. F. Tye, C. E., late chief engineer of the Canadian Pacific Railway, and he will have associated with him James Dix Schuyler, C. E., who is at present a member of the Panama Canal Commission, and an eminent authority on hydraulic construction. W.

BOOK REVIEWS.

"Standard Wiring for Electric Light and Power." By H. C. Cushing, Jr. Fifteenth annual edition, 1909. New York. Published by the author. Flexible leather. 156 pages, illustrated. 4¼ by 6½ inches. Supplied by Electrical Review and Western Electrician for $1.00.

This well-known handbook needs no introduction to electrical workers and engineers. It is generally recognized all over the English-speaking world as the authority on electric-light and power wiring from a fire-underwriter's viewpoint. It has been kept strictly up to date by annual revisions. The 1909 edition has been completely revised by the author, with the assistance of F. E. Cabot, chairman of the electrical committee of the Underwriters' National Electric Association. It contains not only the National Electrical Code, fully explained and illustrated, but the requisite formulæ, tables and other useful data for electric-light and power wiring for both direct and alternating-current circuits. The total number of copies of the book sold since the first edition appeared is now over 170,000, the 1908 edition alone exceeding 20,100 copies.

"Fortschritte der Elektrotechnik" (Progress of Electrotechnics). Edited by Dr. Karl Strecker. Third and fourth quarterly sections of the volume for 1907. Berlin. Julius Springer. Paper, 6½ by 9½ inches. Part III: 447 pages, price 10 m. Part IV: 520 pages, price 15M.

Appearing periodically every quarter-year, this work is a complete digest of the current literature in all branches of the electrical field. In the two sections at hand there are some 6,500 references and abstracts of papers and articles on electrical subjects that appeared during the latter half of 1907 in the many technical journals and engineering societies' publications throughout the world. This is about one-half the total number included in the 1,450 pages constituting the entire volume for 1907. A list of electrical patents issued in Germany, England and the United States in 1907 is also contained in Part IV. The subject and author indexes occupy the last 110 pages. This bibliographical compendium of electrical literature is particularly valuable to the libraries of engineering societies and technical institutions.

"Steam Power Plant Engineering." By G. F. Gebhardt. New York. John Wiley & Sons. Cloth. xxix + 816 pages. 461 figures. 6 by 9 inches. Supplied by Electrical Review and Western Electrician for $6.00.

In this book the author, who is professor of mechanical engineering at Armour Institute of Technology, has made a comprehensive survey of American steam-power-plant practice. In a concise and pithy manner he treats of practically all related problems except detailed design. Prepared as a development of a series of lectures to senior engineering students, this work is more than a technical textbook and will be found generally valuable, at least as a reference, by anyone interested in power-plant work. The general plan of the book is to consider apparatus and methods in the logical order of energy development from the boiler room to the prime movers. On this basis the volume begins with the discussion of fuels and combustion, boilers and boiler auxiliaries, coal and ash handling, natural and mechanical draft, continues with steam engines and turbines, engine-room auxiliaries, such as condensers, feed-water heaters, pumps, piping, etc., and concludes with a study of operation, costs and tests. Two typical power plants are then described, one a steam-turbine central station and the other an engine-driven isolated plant. As appendices are given a general bibliography of power-plant engineering, the American Society of Mechanical Engineers' rules for boiler and engine tests, as well as steam tables and miscellaneous conversion data. Aside from the general bibliography, copious references, principally to the current engineering literature, are given throughout the text, constituting an extremely valuable feature of the book in permitting further study. It is seldom that a textbook is so closely up to date at the time of its publication. The large number of illustrations have been excellently prepared and apparently selected with great care to elucidate the subject fitly. Over 110 tables, many of them containing valuable data on costs and performance, are given with numerous curves showing graphical results. On the whole it is surprising what a fund of information has been logically and systematically compiled in this compact book on so broad a subject.

"Annual Report of the Smithsonian Institution." Fiscal year 1906-07. Washington. Government Printing Office. 726 pages. Illustrated. 5½ by 8½ inches.

The annual report of the board of regents of the Smithsonian Institution for the year ended June 30, 1907, as usual shows the operations, expenditures and condition of the Institution at the time and is made the foundation of its annual publication. As is customary, however, the appendix to the report constitutes the larger part of the volume. It contains accounts of discovery and investigation in nearly all lines of pure scientific research as well as applied science. These articles are mostly reprinted from papers read before various scientific and technical societies at home and abroad. Those of particular interest to electrical readers are as follows: "Some Facts and Problems Bearing on Electric Trunk-Line Operation," by Frank J. Sprague (abstract of the paper presented before the 219th meeting of the American Institute of Electrical Engineers); "Recent Contributions to Electric Wave Telegraphy," by Prof. J. A. Fleming; "On the Properties and Natures of Various Electric Radiations," by Prof. W. H. Bragg; "Progress of Electrometallurgy," by John B. C. Kershaw. There are also articles on the Parsons steam turbine, typical zoological gardens, ethnological and biological subjects, etc.

American Institute of Electrical Engineers' Anniversary Dinner.

The dinner committee of the American Institute of Electrical Engineers, appointed to arrange for an anniversary banquet celebrating the first quarter-century of the society, which was founded in 1884, recently met and decided to hold the dinner at the Hotel Astor, New York city, March 11. The price of the dinner, for which an excellent menu has been provided, is $5 per plate. As usual on these occasions, ladies will participate, and a total attendance of at least five or six hundred is expected. The limited number of speeches will be given by men of national prominence. Attention is being paid to decorations, music and the souvenir menu. Special committees have been appointed, with the following as chairmen: Speakers and menu, T. C. Martin; reception, M. Coster; finance, G. A. Hamilton; tickets and seating, R. T. Lozier; decorations, A. Williams; press and music, G. H. Guy; old-timers, E. A. Sperry.

Chicago Section, Illuminating Engineering Society.

The February meeting of the Chicago Section of the Illuminating Engineering Society was held in the German Room of the Grand Pacific Hotel, Thursday evening, February 18, at 6 o'clock. Dinner a la carte was served.

The subject of the evening was a paper on "Street Lighting," by Walter C. Allen, electrical engineer of the District of Columbia.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER IV. (PART IV.)—TRANSFORMERS.

OPERATION ON OPEN SECONDARY.

In a properly constructed transformer the reactance of the primary is so great

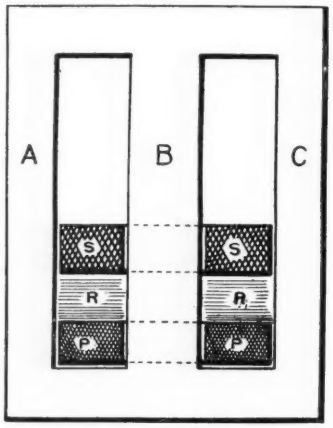


FIG. 106.—PRINCIPLE OF CONSTANT-CURRENT TRANSFORMER.

when the terminals of the secondary are open, that but little current flows in the former when it is connected to an alternating-current source of supply. Only a small amount of energy is then required to make the inductive action of the coil so great as to choke down the current almost entirely. When, however, the secondary is closed, the magnetic energy of the iron core becomes available and is transformed into the energy of the electric current, and the iron core then draws more energy from the primary; that is, the magnetic strength of the former increases and more current flows in the latter.

MECHANICAL ANALOGY.

The action is somewhat similar to the working of an air compressor which is pumping air into a storage tank. If there is no outlet to the tank, the air compressor keeps on pumping only until the pressure reaches the required value, when the unloading device closes the suction inlet, and only such energy is required to run the compressor as is necessary to overcome the friction of the moving parts. When air is drawn out of the storage tank, the pressure drops, the unloading valve opens and the compressor begins working again. So with a transformer, when the secondary is open the iron core soon fills up with magnetism, so to speak, and shuts off to a considerable extent the incoming electrical energy of the primary. When, however, the secondary winding is closed, the magnetism begins to do work by generating a current therein and accordingly draws on the primary for a new supply.

In many cases, as, for instance, in electric lighting, the transformers are used only during a part of the day and must therefore be built with a minimum no-load loss.

CONSTANT-CURRENT TRANSFORMERS.

The constant-current transformer is used where it is necessary to maintain a constant effective value of the alternating current in a circuit rather than a constant voltage between the leads. This is the condition necessary in operating arc lamps connected in series. The constant-current transformer takes a current from a constant-voltage source and delivers a constant current to the arc circuit, regardless of how many arcs (up to full load) are operating.

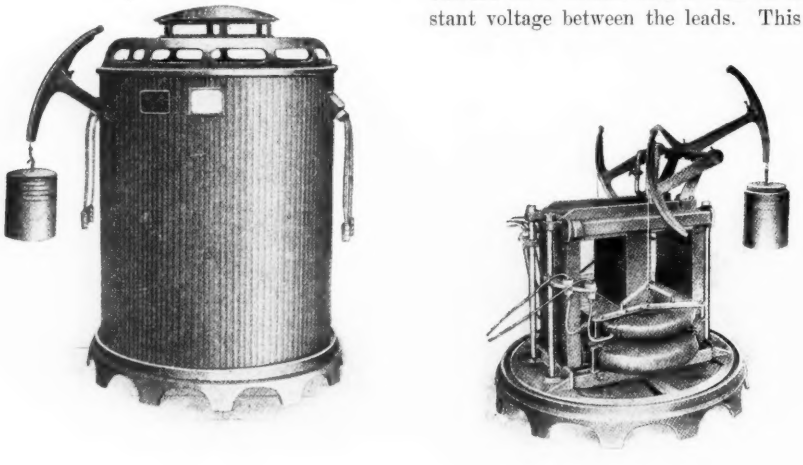


FIG. 107.—CONSTANT-CURRENT TRANSFORMER COMPLETE AND WITH CASE REMOVED.

The method of operation of a transformer of this type is illustrated in Fig. 106, in which A, B and C represent the laminated iron core of the transformer; P represents the stationary primary winding encircling the middle core B, and S the secondary winding, which is balanced by counterpoised weights to move freely up and down the middle core B. When the load changes and a slight increase of current occurs, this causes an increased repulsion between P and S, so that S moves upward, permitting an increased magnetic leakage across the regions R. This decreases the useful magnetic flux through the coil S, reducing the voltage at its terminals so as to maintain a constant current through its circuit.

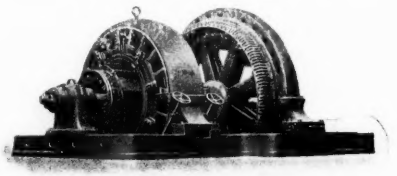


FIG. 108.—1,000-KILOWATT MOTOR-GENERATOR SET.

A complete constant-current transformer is illustrated in Fig. 107. The counterpoised weights accurately balance the upper movable coil, so that it maintains a constant current.

CHAPTER V. (PART I.)—THE CONVERSION OF ALTERNATING CURRENTS.

Alternating-current systems of transmission of electrical energy now find general application, but direct currents are still used for certain purposes, such as electric railways, electroplating and the charging of storage batteries. It is, therefore, often desirable to transform or convert an alternating into a direct current. This, of course, can be done by running a direct-current generator by means of an alternating-current motor.

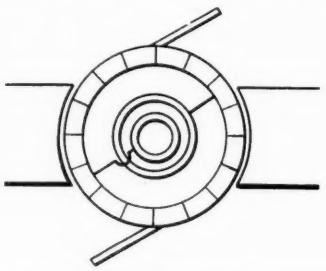


FIG. 109.—CURRENT-COLLECTING CONNECTIONS OF ROTARY CONVERTER.

MOTOR-GENERATOR.

Instead of belting an alternating-current motor to a direct-current generator, the two machines may be mounted on the same base and directly connected as shown in Fig. 108. This constitutes a

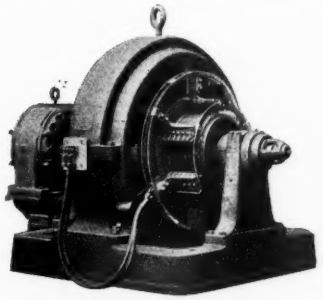


FIG. 110.—DIRECT-CURRENT END OF THREE-PHASE 500-KILOWATT ROTARY CONVERTER.

motor-generator set. As illustrated in Fig. 108, a 1,000-kilowatt, three-wire, direct-current generator supplying electric-lighting service is directly connected to an alternating-current motor.

DYNAMOTOR.

It is not necessary to build two entirely distinct machines to produce the results obtained by a motor-generator. Two electrically distinct circuits can be wound on the same armature, the direct-current winding being connected to commutating segments at one end of the shaft and the alternating-current winding being connected to collector rings at the other end. Of course, the same principle can also be utilized for changing the voltage of a direct current. In either case such a machine is known as a dynamotor.

ROTARY CONVERTERS.

The more common method of conversion of an alternating into a direct current is by means of a rotary converter, which is essentially a continuous-current dynamo having two opposite commutator bars connected to collector rings in case it is a single-phase, double-pole machine, as illustrated in Fig. 109. As distinguished from the dynamotor, the rotary converter has but one armature winding and while part of the current supplied to it is used in producing rotation, most of the current is simply rectified. The only current actually flowing in the armature conductors is the difference between the alternating-current input and the direct-current output.

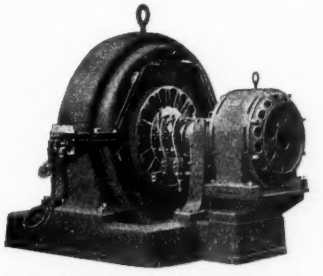


FIG. 111.—ALTERNATING-CURRENT END OF THREE-PHASE 500-KILOWATT ROTARY CONVERTER.

Fig. 110 illustrates a 500-kilowatt three-phase rotary converter viewed from the commutator end, while Fig. 111 illustrates the same converter viewed from the collector-ring end. Both views show the starting motor connected to the same shaft.

Fig. 112 illustrates a complete rotary-converter armature, the small armature at the right being that of the starting motor.

USES OF A ROTARY CONVERTER.

A rotary converter can be operated either as a motor, a generator, or both. As a generator it can be driven by external mechanical power and direct current derived from the commutator or alternating current derived from the collecting rings, or both classes of current may be delivered at the same time.

FIG. 112.—ROTARY CONVERTER ARMATURE WITH ROTOR OF STARTING MOTOR.

It can also operate as a continuous-current motor by connecting the commutator to direct-current supply mains; or it can operate as a synchronous motor by connecting the collector rings to alternating-current supply mains.

When operating as a rotary converter it may either be supplied with a direct current and deliver alternating current, or be supplied with an alternating current and deliver a direct current.

As ordinarily built, however, these machines are used only for the conversion of alternating into direct current, and do not give satisfactory service if used to absorb or deliver mechanical energy. The shaft and bearings of one of these machines are proportioned to carry the armature and not to receive and transmit mechanical power. Likewise, the relation between armature and field is such as to give maximum efficiency for use as a converter, and would not be satisfactory for other purposes.

VOLTAGE.

The ratio between the voltages of the alternating-current end and the continuous-current end of a rotary converter is practically constant and is not affected by changes in speed. Any variation in the voltage of one side produces a corresponding variation in that of the other.

Rotary converters for railway purposes are usually built to deliver a direct current at about 550 volts, when supplied from a two-phase system operating at 385 volts at the collecting rings, or from a three-phase system operating at 330 volts at the collecting rings.

Regulation of voltage is obtained by changing that of the alternating current delivered to the machine. This is accomplished by means of a series winding on the field or by the use of potential regulators.

COMPOUNDING.

In order to obtain constant voltage automatically as the load increases, rotary converters can be compounded, as is done in ordinary generators. This is usually accomplished by means of a series winding on the field, connected to assist the shunt winding, and an inductance in the line between the generator and converter.

Museum of Safety and Sanitation.

Announcement has just been made of the acceptance of the treasurership of the Museum of Safety and Sanitation by Frank A. Vanderlip. An executive office for the administrative and promotive work of the Museum has been opened at the United Engineering Societies' Building, 29 West Thirty-ninth Street.

A committee on plan and scope includes Prof. F. R. Hutton, chairman; Dr. Thomas Darlington, Commissioner of the Health Department of the city of New York; P. T. Dodge, president of the Engineers' Club; William J. Moran, attorney-at-law and Henry D. Whitfield, architect.

Plans are being pushed forward along practical lines to prevent the enormous loss of life and limb to American life and labor, through the Museum of Safety and Sanitation, where safety devices for dangerous machines and preventive methods of combating dread diseases, may be demonstrated. Charles Kirchhoff, editor of *The Iron Age*, is the chairman of the committee of direction; T. C. Martin, editor of *The Electrical World*, vice-chairman, and Dr. William H. Tolman, director.

THE ELECTRIC DISCHARGE AND THE PRODUCTION OF NITRIC ACID.[1]

BY WILLIAM CRAMP AND BERTRAM HOYLE.

It has been calculated that the amount of fertilizer in the form of natural nitrates still available is less than that required for the world's food supply for the next twenty years—that is, assuming that no new sources are discovered. It is this fact which has brought into such prominence the necessity of obtaining a fresh supply of nitrogen compounds, and has consequently led to the erection of large plants for fixing the nitrogen of the air. The weight of nitrogen over every square mile of the earth's surface has been estimated at 2.16×10^7 tons, an amount sufficient, according to Sir William Ramsay, to afford plant food for over 38,400 years' consumption at the present rate. It is evident, then (since the surface of the earth represents approximately 2.02×10^8 square miles), that the amount of nitrogen free at the present moment is sufficient to feed the world's population for approximately 7.75×10^{12} years, and we may well proceed to make use of some of this without interfering appreciably with the proportions of oxygen and nitrogen existing in the atmosphere.

In spite of the many attempts which have been made to fix atmospheric nitrogen, little pioneer work in the way of research has been done to assist the inventor to obtain the best yield from any form of apparatus, and it is with the object of clearing the ground a little in this direction that the work embodied in this paper has been carried out.

Most inventors have attempted to fix the nitrogen of the air by the use of very high temperatures—that is, by really attempting to burn the nitrogen in the presence of oxygen to NO and NO_2, usually by means of the electric arc. In some cases, instead of burning the gases direct, union has been obtained by means of a third substance, such as calcium carbide. Here we shall deal with the former methods only.

THE CREEDS OF INVENTORS.

Each succeeding designer has decided upon some point in the form of the discharge to be used which he believed to be the most important factor in determining the production of the gas. Thus one believes that it is most essential to get the current of air into very intimate relationship with the flame (Naville and Guye). Another considers that the essential condition is to have no continuous flame, but a very large number of arcs (Kowalski and Moscicki). A third thinks that not only is a large number of arcs necessary, but that these should be also very long and very thin (Bradley and Lovejoy). Others

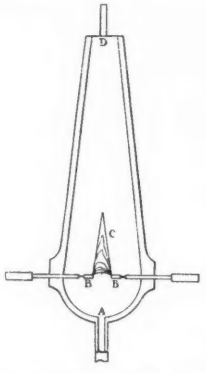


FIG. 1.—APPARATUS OF McDOUGALL AND HOWLES.
A—Air Inlet. B—Electrodes. C—Flame. D—Outlet for Gases.

attempt to combine these results with effects of very high temperature of the gas followed by very sudden cooling; and again, some believe in the effectiveness of temperature gradient alone, whether the arc be large or small.

It can safely be said that none of these systems is complete in itself, but that there is some truth in each. Each has, however, led to a distinct apparatus, which we shall describe shortly, since only by consideration of these can the effect of the possible variables be shown.

APPARATUS RESULTING FROM THE VARIOUS CREEDS AND RESULTS OBTAINED.

1. *McDougall and Howles, Manchester.*—The apparatus proposed is shown in

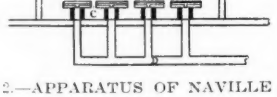


FIG. 2.—APPARATUS OF NAVILLE AND GUYE.
A—Air Inlet. B—Hollow Carbon Electrodes. C—Discharge Gap. D—Outlet for Gases.

the accompanying sketch, Fig. 1; the form, as well as the principle upon which it works, will be clear from the sketch. It is essentially a high-voltage machine working at from 8,000 to 16,000 volts. The results given by this were very poor, but it is only fair to say that the power used was very small. The output obtained will be found in a table herewith, while reasons for failure will be found in the criticisms following.

2. *Naville and Guye.*—The arrangement proposed is shown in Fig. 2, and it will be seen that the arcs set up are in series and that the air to be burned is taken from the outside through the centre of hollow electrodes, thus passing right through the section of the arc. Three gaps in series are used. No figures are available for the output of this apparatus.

3. *Kowalski and Moscicki.*—The apparatus used is depicted in Fig. 3, and is essentially arranged for high voltage and high frequency (from 6,000 to 10,000 cycles per section). It will be obvious that difficulties of insulation and construction are very great. The outputs obtained are given in Table I.

4. *Bradley and Lovejoy.*—These inventors combine a large number of small arcs (as in the last apparatus) with great length obtained by drawing the arc out. The machine consists of a series of rotating electrodes which set up arcs and draw them out from fixed electrodes surrounding them, as shown in Fig. 4. Some justification for this method, and for that previously mentioned, is to be found in the large output shown in Table I. The concentration of acid, as a percentage of the amount of air passed through, is also very good in this process.

5. *Pauling.*—This apparatus is really the reverse of the principle used by Naville and Guye. We have no particulars of the output of this machine.

6. *Werner.*—The principle on which this works is obvious from the diagram, Fig. 5. We have more to say about this apparatus later.

7. *Birkeland and Eyde.*—The arrangement of this machine is shown in Fig. 6. It consists of a pair of water-cooled copper tubes, fifteen millimetres diameter, employed as electrodes. These electrodes are suitable for flames up to 750 kilowatts at 3,500 volts, with a gap of one centimetre. The electrodes are placed in a transverse magnetic field of about 4,000 to 5,000 lines of force per square centimetre in the centre. This field blows the arcs into the form of a large circular fan, the maximum diameter of the flame being about 140 centimetres. The object of the magnetic blow-out arrangement is to increase the rate of cutting of the flame and the air, which is also assisted by the air blast supplied. The furnace in which the discharge takes place is lined with firebrick, and is said to last about six months. The inside temperature of the lining does not rise above 700 degrees C. during nor-

1. Abstract of a paper presented before the Manchester (England) Local Section, Institution of Electrical Engineers, November 3, 1908.

mal working, owing to the cooling effect of the blast of air supplied, although the temperature of the disc of flame is very considerably higher. The results obtained are extremely good, as will be seen by reference to Table I. This is partly because the power employed is large and partly because the rate of cutting the air with the flames is high, both being con-

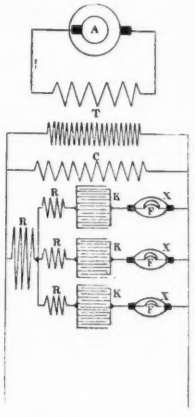


FIG. 3.—KOWALSKI AND MOSCICKI.
T—Transformer. C—Choke Coil. K—Condensers. F—Flame Discharge. R—Resistances.

ducive to efficient working. The object, as will be discussed later, of getting a high rate of cutting the air with the flames is to cool the gases as soon after production as possible, in order to prevent further dissociation.

8. *E. Rossi.*—The method adopted in this case is really similar to those which have preceded it, except that the gases to be combined are submitted to a much

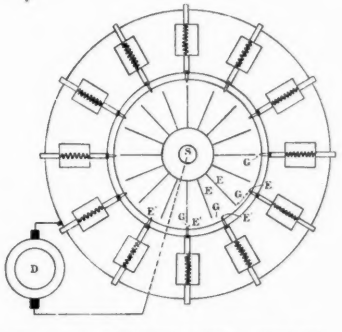


FIG. 4.—BRADLEY AND LOVEJOY.
EE¹ Are Platinum-Tipped Electrodes. D Is 10,000-Volt Direct-Current Generator.

lower temperature, but under much greater pressure; for in this process air at a high pressure (fifty to ninety atmospheres) is heated by being brought into contact with a Nernst glower.

9. *Frank and Caro.*—This process is different from anything previously mentioned, as it consists in forming, first, in an electrical furnace, calcium carbide, and then passing nitrogen over this material when at a red heat, the result being that the nitrogen combines with the calcium carbide forming cyanamide. It is essential for this process that the nitrogen should be free from oxygen, and this is obtained by fractional distillation of the air (Lindt) in the manner now used for producing oxygen. It will be seen from this that oxygen is given off as a valuable by-product.

In all the processes named above, except the last, the object is to produce $NO_2 + NO$, which, when combined with water, gives a mixture of nitric and nitrous acids. From these is then usually produced nitrate of calcium, which is the fertilizer sold. In the last process the cyanamide is sold direct, and decomposes slowly in the presence of water, giving off ammonia, which is absorbed by the soil or taken up by the plants. It is worthy of remark that this substance assists the

TABLE I.—OUTPUTS OF NITRIC ACID OBTAINED BY VARIOUS EXPERIMENTERS.

Experimenter.	Size of Plant, Kilowatts.	Output per Kilowatt-Year, Kilogrammes.
Birkeland	7 to 10	400.0
	200	900.0
Lord Rayleigh	1 (theoretical)	(440.0)
*Moscicki	75	412.0
Bradley and Lovejoy	..	571.0
McDougall and Howles.	0.30	17.7
	0.22	26.7
	0.17	29.4

*These inventors have also used direct-current at 1,500 volts, giving 525 kg. per kilowatt-year.

production of nitrifying micro-organisms, which themselves are germinated in large quantities and sold for use as active fertilizers.

COMPARISON OF THE SYSTEMS.

The first seven methods mentioned above all employ the electric arc. No. 8 makes use of lower temperatures, with special arrangements for effecting the combination desired, while No. 9 uses the arc indirectly. It may be pointed out that at present No. 9 appears to yield the best result per horsepower expended, and from the point of view of cost is certainly better than Chili saltpeter already. This being the case, it is necessary to take steps to find out whether direct combination in the electric arc can ever be as successful as indirect combination, and in order to do this it is necessary to discover upon what factors the production of NO and NO_2 depend.

Now examination of the first seven processes mentioned above shows us that the best results have always been obtained with very large powers, and the difference in the yield between Birkeland's ten-kilowatt and his larger plant is amazing.

The next point which suggests itself is the excellent result obtained by Bradley and Lovejoy from their multitude of small long direct-current arcs, and this result is to some extent verified by Moscicki's yield obtained by the use of very high frequency discharges. It is notable also that whether the plant is large or small the yield is poor if an ordinary hot and thick arc is employed. The results of McDougall and Howles are particularly poor in this respect. Little better is to be expected from either Naville and Guye or Pauling, and if there is one lesson more than another which can be learned from these attempts it is that an arc is

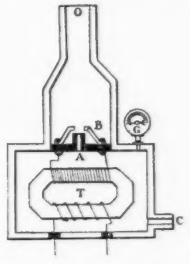


FIG. 5.—PAULING'S APPARATUS.
C—Air Inlet. A—Air Jet. B—Discharge Electrodes. O—Outlet for Gases.

never successful unless made use of to heat a very large quantity of air.

It may appear at first sight as though the process of Birkeland really consists in putting a certain quantity of air through a sheet of flame; but as a matter of fact the effect of the magnetic field in this process is to break up what would otherwise be an ordinary arc into a large number of very rapidly moving arc-threads. It is evident also that the question of temperature is one of considerable importance, since No. 8 is worked with

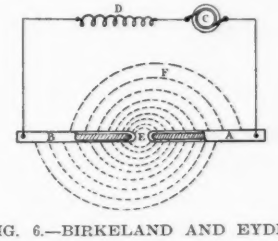


FIG. 6.—BIRKELAND AND EYDE.
A, B—Hollow Copper Water-Cooled Electrodes. C—Alternator. D—Choke Coil. E—Gap (1 Cm). F—Disc of Flame (140 Cm. Diameter).

temperatures which must be comparatively low when contrasted with the electric arc. The questions also of the rate at which the air should move through the flame, of the current to be used for a given volume of air, of the changes produced by varying the current, of arc-length and frequency, all must be determined before any really highly efficient apparatus can be de-

signed. It seemed safe for us to assume that good results are only to be obtained by the use of thin flames, with very rapidly moving arc-threads used to heat suddenly quantities of air which are as quickly as possible cooled again. For this reason the apparatus selected for experimental results was a modification of that suggested by Werner.

The apparatus used for the experiments, shown in Fig. 7, consisted of a high-tension transformer excited by means of an alternator and used to feed on its high-tension side a pair of phosphor-bronze ribbon electrodes shaped almost like the well-known horn lightning arresters. The nozzle A was supplied with air from an air-pump and receiver, so that the air had time to cool after being compressed before issuing from the nozzle.

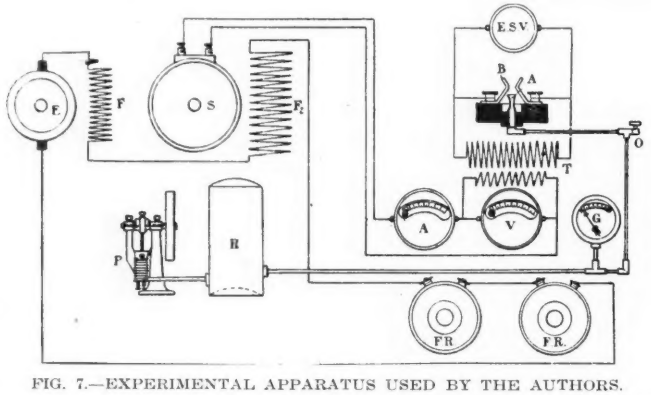


FIG. 7.—EXPERIMENTAL APPARATUS USED BY THE AUTHORS.
A—Laval-Shaped Glass Nozzle. B—Electrodes. O—Air Outlet. F. R.—Field Rheostats.
F, F,—Exciter and Alternator Fields. S—Stator of Alternator.

The detailed description of the apparatus used is as follows:

The air-pump was capable of giving about four cubic feet of air per minute at a pressure of ten pounds per square inch, and was connected, as shown in Fig. 7, to a receiver, in order to equalize the pressure on the jet—i. e., to prevent the beats of the pump affecting the blast and flame discharge, and also to lower the temperature of the air as it passes to the jet. The speed of the machine was 180 revolutions per minute. A pressure gauge was connected in the air main from the receiver to the nozzle, also an outlet was provided in order to regulate the pressure used.

The alternator was a Cramp self-excited machine with a very drooping characteristic, which, as will be explained later, is very suitable for giving a steady continuous discharge through the air-blast. The field was controlled by large resistances, allowing very wide regulation. The speed of the machine was 1,200 revolutions per minute and the frequency 160.

Ammeters and voltmeters were regularly employed on the low-tension and high-tension sides of the transformer. A choking-coil and series resistance were used sometimes on the low-tension side. The transformer had a ratio of transformation of 100 to one.

Mr. Werner's object in using this type of discharge was to obtain a quickly expanding blast of air, for he believed that the natural cooling produced by the quickly expanding gas would of itself materially assist in the production of the desired peroxide. He used a flat-ended nozzle perforated with nine tiny holes. We did not think that this form could be the best for general purposes, and therefore decided first of all to examine different shapes of nozzles with the object of obtaining the best type for the work. After a short examination of various types it was decided that a shape like that known as the "Laval" nozzle would be best as a general type, and various sizes of these were made in glass and were measured and tested, as will be seen by the detailed results given later.

With regard to the apparatus chosen, it may be said that the shape of flame approximated closely to a section taken between two radii, about sixty degrees apart, of the Birkeland disc flame. The air velocity through this section being variable, admits of a very wide range of experiments both as to air quantity and consequent flame temperatures. Guides at the sides of the electrodes enabled the path of the air to be practically confined to the active area of the discharge, and this alone was found to make a considerable difference to the amount of acid produced.

The conditions under which a discharge can be produced and steadily maintained with an apparatus of this sort first claim attention.

[To be continued.]

Preservative Treatment of Telephone Poles and Cross-Arms in Louisiana.

A co-operative agreement between the United States Forest Service and the North Louisiana Telephone Company for the investigation of economic methods for the preservation from decay of loblolly-pine telephone poles, has recently been carried out with gratifying results. The object of the government was to demonstrate that a creosote treatment could be applied successfully and at a low cost to loblolly-pine poles. Such success was obtained that a company has been incorporated under the name of the Louisiana Creosoting Company, which will operate commercially the plant designed by the Forest Service.

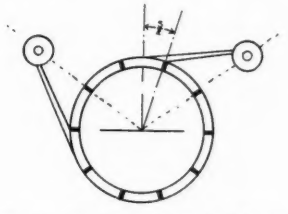
The treating plant, which has been in operation since the latter part of last October, is of the "non-pressure," or "open-tank" type. The installment of this style of plant costs much less than a plant of the "pressure" type, which is the ordinary type of plant for commercial purposes throughout the country. The open-tank system depends fundamentally upon the immersion of timber first in a hot bath of the preservative, followed by a rapid change to a cold bath. This method does away with the installation of high-pressure and vacuum pumps and a treating cylinder of massive construction to withstand a high internal pressure, which are necessitated by a plant of the pressure type. It is usual, however, to install a treating cylinder of light construction where any great quantity of material is to be treated, since the cost of handling the material and loss of preservative, through volatilization during the hot bath, is in this way reduced to a minimum. The new open-tank system is admirably adapted to the treatment of certain classes of timber, and especially so as regards loblolly pine.

The plant used in the experiment with the North Louisiana Telephone Company is equipped with a horizontal treating cylinder fifty feet long and six feet in diameter. It was designed by the Forest Service, whose representative also supervised its construction and operated the plant for several months. During this period, 3,000 poles, 2,500 cross-arms and 500 ties were treated, an amount sufficient to determine the most economical methods of treating these classes of material. The Forest Service therefore withdrew from the co-operation, and the plant is now being successfully operated by the owners.

QUESTIONS AND ANSWERS.

SETTING OF BRUSHES ON COMPOSITE ALTERNATORS.—In the article published on page 992 of your issue for December 26 last, directions are given for setting the rectifying brushes on the commutator of a composite alternator. What would be the result in the action of the machine if both leading brushes were set farthest from the poles?—T. E. S., La Crosse, Wis.

The directions given in the article in question correspond to the instructions issued by one of the leading electric manufacturing companies on the operation and care of machines of this type. These instructions were based on an extensive practice with these machines and are the rules found necessary to give sparkless and reliable operation of the machines. If both leading brushes are set farthest from the poles, it is found that the influence of the stray magnetic field from the poles is not compensated as completely as when the directions are strictly



SETTING OF RECTIFYING BRUSHES.

followed, and therefore the compounding action is not so satisfactory and the sparking is worse.

INVENTION OF STORAGE BATTERY.—When and by whom was the storage battery invented?—A. S. L., Charlottesville, Va.

The storage battery was invented by Gaston Planté, a French physicist, who in 1860 built one from two sheets of lead separated by a felt cloth and then rolled up and placed in a jar of dilute sulphuric acid. A method of "forming" the plates was also devised by Planté. No very radical changes were made in the storage battery until the invention of the "pasted" type of plate, about 1880.

B. & S. GAUGE SIZES.—Kindly give me the exact size in decimals of Nos. 16, 14, 12, 10, 8, 6, 4, 2, 1, 0 and 00 B. & S. gauge copper wires.—F. B., St. Louis, Mo.

The sizes desired are given in the table below, diameters being in decimals of an inch and cross-sectional areas in circular mils (square of diameter in mils or thousandths of an inch):

No.	Diameter.	Area.
16	0.05082	2,583
14	.06408	4,107
12	.08081	6,530
10	.1019	10,380
8	.1285	16,510
6	.1620	26,250
4	.2043	41,740
2	.2576	66,370
1	.2893	83,690
0	.3249	105,500
00	.3648	133,100

UNITED STATES CIVIL SERVICE APPLICATIONS AND EXAMINATIONS.—Recently I heard of an examination for stationary engineer in the United States Civil Service, but could not find out where or when it was to be held. Where can I get this information and can any one that wishes take the examination?—A. J. K., Harrison, Tenn.

The examination referred to probably was for the position of stationary engineer in the Indian Service, for which an examination was held a few days ago. Any citizen of the United States desiring to enter the civil service may get information in regard to positions in any particularly chosen line, dates and places where examinations for such positions are to be held, application blanks and any other information relating to the civil service by writing to the United States Civil Service Commission, Washington, D. C. In writing for general information it is well to ask for the manual of examinations, a pamphlet of about eighty-five pages, issued semi-annually and giving a fund of information in regard to all branches of government civil service. A person wishing to take an examination should write for an application blank and state definitely what position is sought. The application form when received should be carefully filled out in accordance with the instructions printed thereon and mailed without delay to the United States Civil Service Commission, Washington, D. C. This application should be received at Washington at least a week or ten days before the date announced for the examination. If received by the Commission in sufficient time to arrange for the examination and if the applicant is found to be entitled to the examination requested, a card will be sent to him admitting him to the examination and a set of questions for him will be sent to the place of examination. No recommendations other than those called for by the application form will be considered. Civil-service examinations are held in every state and territory of the country except Alaska. An applicant presenting himself for examination must provide himself with pencils, pens, ink and erasers, but no paper or blotters; handbooks and books of reference are not permitted except when specifically so stated in the examination sheets.

UNIPOLAR DYNAMOS.—Kindly give me a short description of the unipolar dynamo. Has it been made practical and how does it operate? I have heard that the General Electric Company has made extensive tests of this type of machine.—M. R. B., Chicago.

The unipolar (or homopolar or acyclic) dynamo is a generator whose armature conductors cut through a uniform and unidirectional magnetic field, thus producing a strictly direct and constant electromotive force. These machines are usually provided with one or two parallel field coils, wound around and concentric with the shaft, so as to be almost completely surrounded by the iron frame of the machine. The armature consists either of a disc or a cylinder rotating in the air-gap between the two magnet poles. The current is taken off by means of brushes bearing directly on the circumference of the disc and on the shaft or at the ends of the cylinder. The disc type is known as the radial type because the currents pass radially across the disc, the cylinder type is known as the axial type, because the currents pass parallel to the shaft, as in an ordinary generator. Acyclic generators may be made in many forms, some having several armature conductors placed in series, so as to get a higher voltage. In general, this type of machine generates low voltages and high currents and must run at very high speed. It is particularly adapted for use in electrolytic work, such as electroplating and other electrochemical processes requiring large direct currents at low voltage. Jakob E. Noeggerath has invented a number of machines of this type which have been built by the General Electric Company. Probably the largest of these ever built was a 300-kilowatt, 500-volt generator, described in the Transactions of the American Institute of Electrical Engineers, Vol. 24, 1905.

No Passengers Killed in Indiana.

The quarterly bulletin of the Indiana Railroad Commission, just issued, sets forth the information that there has not been a passenger killed on a steam or an interurban railroad in Indiana during the past nine months. Conditions in Indiana during the past twelve years have been such that the annual death harvest has never failed to fall under ten persons. While gratified over the showing made during the past nine months, the Commission laments the fact that the number of the employes meeting death is increasing year by year. Twenty-five were killed during the period. S.

The Chicago Automobile Show.

Transformed from its more brilliant dress of the preceding fortnight, when the Electrical Show occupied the Chicago Coliseum, every available space in the big structure, including main floor, galleries and basement of both auditorium and annex, as well as the floor and gallery of the First Regiment Armory, February 6 to 13, was occupied with the exhibits of the $3,000,000 Chicago Automobile Show.

Three hundred exhibitors showed every kind of self-propelled vehicle and accessory on the market, from big six-cylinder limousines to graceful, silent electrics, and searchlights to the modest but vital spark-plugs. In point of numbers, of course, the gasolene cars led. Correspondingly, manufacturers of ignition systems, magnetos, batteries, coils and spark-plugs were present in force.

A feature of the show was the increasing attention accorded the electric vehicles, whose qualities of reliability, ease of manipulation, silent running and mechanical simplicity have earned an appreciation accorded no other class of machines. And the territory of the battery-propelled vehicle is extending beyond its former restriction as a "town car," for several exhibits at the show included electric automobiles, designed along the lines of the gasolene touring car and adapted to making century trips over country roads. The electrics will make a strong bid to take part in the Glidden tour of 1909. Oliver P. Fritchle, who returned from a 2,140-mile tour in his electric, averaging ninety miles a day over Alleghany Mountain roads, while at the show addressed a letter to the managers of the tour asking for a formal entry.

For the Automobile Show the decorative scheme utilized the colors green and bronze. The arched roof of the Coliseum was draped in bunting marked with rows of electric lights. The booth divisions were bronzed bas-reliefs of spirited automobile scenes, the partitions being capped by boxes of growing plants. Paintings depicting a variety of motoring landscapes bordered the walls of the building. The scheme of illumination was not intensely bright but sufficient and comfortable.

The significance of the Chicago Automobile Show will be understood from the daily attendance of 35,000 persons, who purchased 3,000 machines at a price of $3,700,000 and spent another million in accessories.

The Duplex Coil Company, Fond du Lac, Wis., exhibited its Duplex spark coil, the feature of the construction of which is the use of two cores, two primary and two secondary windings, with one vibrator. This construction is designed to secure economy of current consumption, at the same time producing an extremely hot secondary spark coupled with great reliability.

Fulton & Zinke, Chicago, attracted attention with their exhibit of Reliance spark-plugs, having arranged four of these gaps to spark under water. In this plug the insulated sparking point is a fine platinum wire baked into the porcelain. The scouring action of the spark is designed to destroy any short-circuit matter around the gap.

The Witherbee Igniter Company, Chicago, made the Volta high-tension magneto a feature of its exhibit. This generator requires no coils or vibrators, and produces an extremely hot, flaming spark. The electric connections are, of course, very simple.

The Joseph Dixon Crucible Company, Jersey City, N. J., made an exhibit of a number of its lubricating products useful for automobile purposes. A set of transmission gears running in graphite lubricant was an interesting feature of this booth.

The Studebaker Brothers Manufacturing Company, South Bend, Ind., made a handsome exhibit of its line of electric automobiles. Representatives of the company at the booth also distributed circulars describing the economy of operation of this class of vehicle when charged from rectifying apparatus in one's own private garage.

The High-Frequency Ignition Coil Company, Los Angeles, Cal., showed a working exhibit of its Seeley ignition system, presenting the initial adaptation of high-frequency discharges to the ignition of automobile engines. This system employs no mechanical moving parts, is of rigid construction and is said to be very economical.

The Standard Ignition Company, Chicago, showed its multiple-speed spark generator and its combination distributor and timer, which secures three distinct spark-speed volumes by the manipulation of a small switch.

The Vivax Storage Battery Company, Chicago, showed its products adapted for the ignition of automobile engines, the supply of automobile electric lamps and the propulsion of electric vehicles.

The Anderson Carriage Company, Detroit, Mich., attracted considerable attention with its exhibit in the First Regiment Armory, comprising a handsome line of Detroit electrics. An exquisite car of its collection was one externally finished in a royal mauve and upholstered in pearl-gray satin.

The Columbus Buggy Company, Columbus, Ohio, exhibited a graceful, stylish and comfortable Victoria phaeton, as well as a number of other electric vehicles of unusual beauty in grace and design.

The National Coil Company, Lansing, Mich., made an exhibit of its National magnetos, which have, as a feature of their construction, a system of magnetic fields that insure them against demagnetization.

The Baker Motor Vehicle Company, Cleveland, Ohio, exhibited a stripped chassis of one of its machines showing the arrangement of its electric controller manipulated from the steering-wheel shaft. This controller embodies a form of construction which is designed to avoid "freezing" even in the case of sudden heavy loads.

The Connecticut Telephone and Electric Company, Meriden, Conn., showed several styles of Connecticut timers and distributors, which are designed to derive the maximum power from the motor by securing the correct timing of the spark on high speeds as well as low speeds.

The Magnet Motor Company, Chicago, showed the 1909 models of its Magnet motorcycles which are of German construction.

The National Battery Company, Buffalo, N. Y., exhibited a number of its types of cells designed for pleasure and commercial vehicle service, as well as ignition batteries for gasolene automobiles.

The Pittsfield Spark Coil Company, Dalton, Mass., showed the Pittsfield magneto, which is built after a new design. The high-tension current is generated in a stationary coil, without any moving wire on the armature. Four sparks are produced at each revolution of the armature.

The Electric Storage Battery Company, Philadelphia, Pa., had an exhibit of special batteries which it has designed for the makers of a number of standard vehicles.

The Heinze Electric Company, Lowell, Mass., exhibited its low-tension magneto operating through vibrating spark-coils to plugs. The magnets of its generator are annular in form, providing a compact external appearance.

The National Carbon Company, Cleveland, Ohio, showed an instructive exhibit which demonstrated the relative effectiveness of different arrangements of batter-

ies in the primary circuit of a spark-coil. By means of rotating electrodes it was shown that the most efficient arrangement is that which secures a single hot spark sufficient to ignite the mixture.

The Remy Electric Company, Anderson, Ind., exhibited its high-tension alternating magneto, which has a stationary winding. The magneto winding is directly connected, through the circuit-breaker, with the spark coil, and the circuit is mechanically broken during the half-time shaft, and a spark coil complete with condenser and switch for the dashboard.

The C. A. Shaler Company, Waupun, Wis., attracted attention with its electric vulcanizer. This vulcanizer does the work quickly and simply. Its heat control is automatic and it is inexpensive to operate, a tube repair, for instance, costing less than three cents, and a casing repair less than five cents.

The Warner Instrument Company, Beloit, Wis., showed several styles of its Warner auto-meter. This device employs a magnetic principle in its tachometer part and thus does away with crude centrifugal and pressure devices. The Warner autometer begins to register as soon as the car begins to move. The commercial instrument may also be provided with an odometer and clock.

Wheeler & Schebler, Indianapolis, Ind., exhibited an inductor type of alternating-current magneto, friction driven from the flywheel. The company makes a master vibrator with a very supple oscillating spring, which enables it to synchronize with the wave flux of current.

The Vesta Accumulator Company, Chicago, exhibited batteries for sparking purposes and others designed to be carried on gasolene cars for the supply of the service lamps. Vesta single-cell storage-battery outfits attached to a small hand-lamp were explained to be often useful in the examination of automobile mechanism.

MAIN FLOOR, COLISEUM, CHICAGO AUTOMOBILE SHOW, FEBRUARY 6 TO 13.

current wave, which is of the nature of an abrupt rise and fall, with a flat peak.

The American Electrical Novelty and Manufacturing Company, Chicago, maker of Ever Ready dry batteries, showed a number of useful flash-lamps and pocket meters. By the use of the new Osram filament these flash-lamps secure the long life of a very brilliant light.

The Atwater Kent Manufacturing Works, Philadelphia, Pa., showed its Unisparker. This consists of two separate units, a contact-maker and distributor on

The Whitney Manufacturing Company, Hartford, Conn., exhibited its well-known line of roller chains, block chains, quiet chains, Wizard chains and chain belts.

The Motsinger Device Manufacturing Company, Chicago, introduced as a feature its Auto-sparker charging board, which comprises a voltmeter arranged through a plug switch to be electrically connected to the source of generator supply and the storage battery, as desired. The Auto-sparker of this company, as is well known, is a self-exciting, direct-cur-

rent generator, and the device has found wide use.

The Chicago Battery Company, Chicago, presented some interesting facts about J. & B. spark coils which are constructed on the unit system. The Type J vibrator has a very simple adjustment which utilizes a new principle. An overload feature makes it impossible for it to consume more than three-quarters of an ampere, insuring the battery against overexhaustion.

The Veeder Manufacturing Company, Hartford, Conn., showed those of its products applicable to automobile work. These comprised cyclometers, odometers, tachometers, tachodometers, counters and fine castings.

C. F. Splitdorf, New York, exhibited the Splitdorf magneto, the Splitdorf synchronized distributing coil and the Common Sense spark-plug. The Splitdorf magneto is adapted to operate satisfactorily at any desired speed and to deliver results with the minimum amount of attention.

The Woods Motor Vehicle Company, Chicago, showed a fine line of its electric vehicles. The Woods transmission system employs a motor with its shaft parallel to and connected through gears to a countershaft driving, by means of sprockets, the wheels. These vehicles are made in many artistic styles.

The Babcock Electric Carriage Company, Chicago, exhibited a handsome line of its electric vehicles. These machines, which are ideal for town and ladies' use, may be furnished with wheel steer. The transmission is through twin sprocket chains.

The Waverley Company, Indianapolis, Ind., called attention to the new Waverley driving system, which departs from the well-known transmission arrangement formerly employed, supporting the motor on the body with rubber cushions to overcome vibration. The power is transmitted by a silent chain running in oil to the floating rear axle, from which a small herringbone gear transmits power to the wheel shaft.

The K-W Ignition Company, Cleveland, Ohio, exhibited its Motor-boat Special magneto, coils and spark-plugs.

The Chicago Recometre Company, Chicago, Ill., exhibited an ingenious device which furnishes a log of the car movement during any time. The trap is uniformly driven by a clock movement while the stylus is transversely operated with the completion of each mile of car movement.

The Pfanstiehl Electrical Laboratory, North Chicago, Ill., called attention to its exhibit of coils with an ingeniously constructed Geissler tube formed to the script letters of the name "Pfanstiehl," and illuminated by the high-tension discharge.

The Champion Ignition Company, Flint, Mich., made a feature of its A. C. spark-plugs, together with an exhibit of rubber-covered primary and secondary wires.

The Vanguard Manufacturing Company, Joliet, Ill., exhibited its Vanguard spark-plug, which, it claims, cannot be fouled or short-circuited.

The Rauch & Lang Carriage Company, Cleveland, Ohio, showed a number of graceful electric vehicles.

Robert Bosch, New York, Incorporated, showed the new Bosch arc-flame magneto-electric ignition system with stationary armature for multicylinder automobile motors.

American Association of Electric Motor Manufacturers.

The winter meeting of the American Association of Electric Motor Manufacturers, held at Hotel Schenley, Pittsburg, Pa., January 26 to 28, was attended by fifty-two members and ten guests.

The following papers were presented before the convention: "Ratings and Guarantees of Alternating-current Motors," R. S. Feicht; "Temperatures in Semi-enclosed and Enclosed Motors," J. M. Hipple; "Methods and Cost of Testing Alternating-current and Direct-current Motors," L. E. Underwood; "Starting Devices for Alternating and Direct-current Motors," H. D. James; "Standard Voltages," P. M. Lincoln; "Relation of the A. A. E. M. M. with Central Stations," Fred M. Kimball; "Relation of the A. A. E. M. M. with Other Manufacturing Associations," Charles Robbins; "Unprofitable Advertising," Rodman Gilder.

On Tuesday evening, at the pool and billiard tournament, the pool prize was won by H. H. Smith, Chicago manager of the Diehl Manufacturing Company, and the billiard prize by R. G. Kellogg, of the Mechanical Appliance Company, Milwaukee, Wis. The prize for each contest was a billiard cue in a leather case.

On Wednesday afternoon the members left on special cars for the Westinghouse Electric and Manufacturing Company's works at East Pittsburg, where luncheon was served, after which the party was accorded the opportunity of inspecting the works. On Wednesday evening, the association dinner was held at Hotel Schenley, and was a most enjoyable affair. Music and songs were substituted for speeches.

The reports of the various committees were presented during the session, and final action taken by the association. Information will be given at a later date in regard to the standards adopted by the association.

The annual convention of the association will be held at Hot Springs, Va., May 17 to 20.

The German Tax on Electricity.

The proposed tax in Germany on gas and electricity, and also on sources of light, including electric incandescent lamps and arc lamps, has given rise to keen dislike and opposition on the part of consumer and producer alike, writes a continental correspondent of *The Illuminating Engineer,* London.

The taxes on incandescent lamps are rated as follows, one pfennig being approximately equal to one-quarter cent:

(1) 0 to 15 watts, 5 pfennigs each
(2) 15 to 25 watts, 10 pfennigs each
(3) 25 to 60 watts, 20 pfennigs each
(4) 60 to 100 watts, 30 pfennigs each
(5) 100 watts upward, 50 pfennigs each

A carbon-filament incandescent lamp, yielding sixteen hefner-candles, consumes about forty-eight watts, falls under the third heading, and is taxed twenty pfennigs. The cost of renewal of such lamps is today about twenty pfennigs, and their original cost about thirty pfennigs. The effect of the tax is, therefore, to increase the cost of the lamp eighty to 100 per cent.

A metallic-filament lamp, on the other hand, consumes, say, about fifty watts and yields fifty hefner-candles, and thus also is subjected to a tax of twenty pfennigs. But the initial cost of such a lamp amounts to three marks ($.75), and therefore the effect of the tax is only to increase this by seven per cent.

It may also be noted that arc lamps are free, but carbons are taxed at the rate of one mark ($.25) per kilogramme. In addition, mercury-vapor lamps of 100 watts consumption are taxed one mark.

The tax on carbons would increase their cost, in the case of open arc lamps, by about 100 per cent, and would be felt most severely in the case of flame arc lamps. This would tend to assist the retention of enclosed arc lamps, which are economical in carbon consumption, but in danger of being ousted by flame arcs.

Annual Report of the United States Patent Office.

Commissioner of Patents Edward B. Moore has submitted to Congress his report of the business of the United States Patent Office for the year 1908. It shows a marked improvement in practically all transactions. During the year there were received 60,142 applications for mechanical patents, 1,131 applications for design patents, 202 applications for reissues of patents, besides 8,857 applications for the registration of trade-marks, labels and prints. There were issued 33,514 patents on inventions and designs, 168 patents were reissued and 6,029 trademarks, labels and prints registered. The number of patents that expired was 22,328. The number of allowed applications awaiting the payment of final fees was 12,269, and the number forfeited for nonpayment of final fees 6,502. The total receipts were $1,896,847.67, the expenditures $1,712,303.42. The total balance to the credit of the Patent Office in the Treasury of the United States on January 1, 1909, was $6,890,725.89. This represents the accumulation of the annual surpluses.

In proportion to population more patents were issued to citizens of the District of Columbia than to those of any state—one to every 1,115. Next in order are the following: Connecticut, Colorado, California, New Jersey, Washington, Nevada, Massachusetts, New York, Illinois. The fewest patents granted in proportion to the number of inhabitants were in the following order: Mississippi, one to every 15,992; Hawaii, one to every 14,000; Alabama, one to every 13,647; Arkansas, one to every 11,710, and North Carolina, one to every 10,941. As to foreign patents, there were granted to citizens of Germany 1,013 patents; to those of England, 734; Canada, 444; France, 302; Austria-Hungary, 109; Switzerland, 106; other countries are in order: Sweden, Belgium, Italy, Scotland, New Zealand, Russia.

The reorganization of the Patent Office under the system inaugurated by Secretary Garfield has resulted in vastly improving the conditions heretofore existing. The Bureau has been given twenty-three additional rooms. The force has been augmented by forty-four examiners and forty-four clerks and messengers. The salaries have been increased by $270,820. Inasmuch as the salaries of the examiners had not been increased for a period of sixty years, it has been most gratifying that this Congress has come to the relief of the Patent Office in so liberal a manner.

The commissioner says: "I take great pleasure in reporting that in view of the new conditions created by Congress and the Secretary of the Interior, it has been possible to bring up the work of the Patent Office so that it is now current except in five examining divisions out of the forty-one. The work in these five divisions is in such a condition that it will be made current within thirty days or less. The work done now is very thorough, and with the present force it will be possible to act on and pass to issue or reject the average application for patent within from thirty to sixty days after filing in the office."

The establishment of the new classification division provided will enable the Patent Office to have all the United States patents, which now number 915,000, the foreign patents, about 2,000,000 in number, and the subject-matter embraced in the 85,000 volumes in the scientific library properly classified and digested. When this is accomplished the work and expense of examination will be lessened by one-third and the future patents issued will have a greater degree of validity attached to them. This system of classifying technical subject-matter is quite perfect in Germany and England, and it is of the greatest importance to complete such a classification in the United States office at the earliest possible date.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

NARRAGANSETT ELECTRIC.

The annual report of the Narragansett (R. I.) Electric Lighting Company for the year ended December 31, 1908, shows as follows:

Gross, $1,088,364; operating expenses, $646,008; net, $442,356; interest charges, etc., $32,453; depreciation, $75,000; surplus, $334,903 (equal to 8.3 per cent on the $4,000,000 capital stock); dividends, $320,000; net surplus, $14,903.

ILLINOIS TRACTION.

The Illinois Traction System's report for the year ended December 31, 1908, compares as follows:

	1908.	1907.
Gross	$4,098,620	$3,779,187
Expenses and taxes	2,354,124	2,128,488
Net	$1,744,496	$1,650,699

The increase for the year 1908 is largely attributed to income from the express service which was instituted last year.

NEW YORK & QUEENS COUNTY RAILROAD COMPANY.

The Public Service Commission has made public the report of the finances of the New York & Queens County Railway Company, the Belmont system in Queens. The report, which is for the year ended June 30 last, shows that the lines carried 18,621,355 passengers, an increase of 510,894 over the preceding year. This is the balance sheet:

ASSETS, 1908.

Cost of road and equipment	$ 8,322,583.34
Materials and supplies	85,105.51
Bills and accounts receivable	11,274.32
Cash	44,335.64
First and refunding mortgage 4 per cent bonds*	2,042,327.55
Prepayments	5,831.53
Total debits	$10,511,457.89

LIABILITIES.

Capital stock	$ 3,235,000.00
Funded debt	3,000,000.00
Current liabilities, matured and unpaid	1,485,612.69
Current liabilities unmatured	730,565.07
First and refunding mortgage 4 per cent bonds	*2,042,327.55
Total credits	$10,493,505.31
Corporate surplus	17,952.58

The corporate surplus shows a decrease of $219,097 as compared with 1907.

CAPITAL TRACTION COMPANY.

The Capital Traction Company of Washington reports for the year ended December 31, 1908. The income account compares as follows:

	1908.	1907.
Gross	$1,841,170	$1,764,345
Expenses	793,141	903,481
Net	$1,048,029	$ 860,864
Other income	14,804	22,163
Total income	$1,062,833	$ 883,027
Interest, taxes and renewals	290,947	91,500
Surplus	$ 771,886	$ 791,527
Dividends	720,000	720,000
Surplus	$ 51,886	$ 71,527

The surplus for dividends, $771,886, after charging off interest, taxes and $70,117 for renewals in the Chevy Chase Line equals 6.42 per cent earned on the $12,000,000 capital stock.

SEATTLE ELECTRIC.

The report of the Seattle Electric Company for the month of December and twelve months ended December 31 compares as follows:

	1908.	1907.
December gross	$ 415,079	$ 376,805
Expenses	253,801	229,582
December net	$ 161,278	$ 147,223
Charges and taxes	83,802	76,689
Balance	$ 77,475	$ 70,534
Bond sinking fund	11,511	7,280
December surplus	$ 65,964	$ 63,254
Twelve months, gross	4,520,488	4,119,724
Expenses	2,670,252	2,421,404
Twelve months, net	$1,850,236	$1,698,320
Charges and taxes	989,374	832,941
Balance	$ 860,862	$ 865,380
Bond sinking fund	101,271	87,360
Twelve months, surplus	$ 759,591	$ 778,020

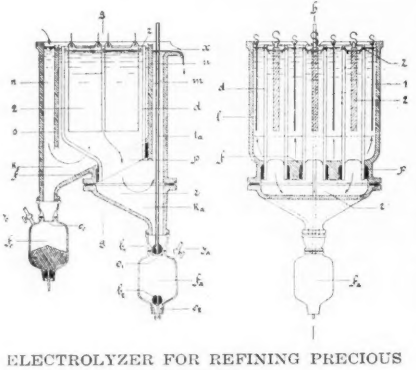
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

AN ELECTRICAL ANEMOMETER.

Prof. R. B. Goldschmidt, of the University of Brussels, has recently perfected an electrical anemometer. It is known that the resistance of a platinum wire in an electric circuit increases with the temperature to which it is subjected; but if its temperature is lowered, as by cooling the atmosphere surrounding it, the temperature equilibrium between the wire and the adjacent layer of air is destroyed, and an ampere-meter inserted in the circuit will immediately indicate an increase in the conductivity of the wire. This fact has been made use of by Professor Goldschmidt in his apparatus. The natural temperature of the air, however, may have a certain influence on the resistance of the wire, and therefore the intensity of the current it allows to pass does not, in itself, furnish exact indications of an anemometer. The conductivity of the platinum wire exposed to the wind must be compensated by that of another identical wire protected from the wind and influenced only by the surrounding temperature. For this reason two wires are made to constitute two of the branches of a Wheatstone bridge, the other two branches being formed by two resistances of equal value; and a galvanometer connected in the bridge will remain at zero when there is no wind to affect the exposed platinum wire, even though the temperature rises or falls. The wire protected from the influence of air currents nevertheless assumes the temperature of the surrounding atmosphere and compensates by its own variations of conductivity those of the other wires exposed to the wind. The resistance of the latter is therefore independent, in a certain measure, of the temperature of the air, and the changes in its conductivity are determined solely by the velocity of the wind. The advantage of this new anemometer is that it has no moving parts and that its indications may be read at a distance. A suitable registering galvanometer may be employed for making a permanent record of the variations in the velocity of the wind. As in meteorological stations, it is often of importance to determine the velocity of the wind with respect to its direction. Professor Goldschmidt has combined a weathervane with his anemometer, the indications of which can be electrically transmitted and registered at a distance.—*Translated and abstracted from L'Electricien (Paris), January 15.*

ELECTROLYZER FOR REFINING PRECIOUS METALS.

The apparatus illustrated in the accompanying figures is intended for refining metals, especially precious ones, by electrolysis. It contains two compartments separated from each other by diaphragm walls, namely: (1) the anode chamber formed by the inner space of the cell diaphragm *d*, the tank *r* and the channel *m* leading to the flow-off *x;* (2) the cathode chamber consisting of the outer space of diaphragm *d* and the funnel-



ELECTROLYZER FOR REFINING PRECIOUS METALS.

shaped tank K*a*. It is confined by the walls *n, s,* and the inclined bottom *f*. The anodes 2, consisting of the alloys to be electrolytically treated, are hung up inside of the diaphragms; the cathodes 1, upon which the pure metal is deposited, hang in the cathode chambers outside of the diaphragms. The electrolyte consists of nitrate of silver or copper, copper sulphate or chloride of gold, according to whether the metal predominating in the anode alloy and to be separated in pure condition is silver, copper or gold. The electrolyte circulates continuously in the apparatus, so that the electrodes regularly come in contact with it. For this purpose it is introduced through the channel *n* and is compelled to enter the cathode chamber from the bottom. There it rises along the cathodes and enters into these through the opening Z or the walls of the diaphragms, flows down along the anodes into the space *r* and up into the channel *m* to the flow-off *x*. Under the influence of the current flowing from anodes to cathodes the former are attacked and their soluble substances go into the electrolyte. If the tension is well regulated the soluble substances are deposited on the cathodes while the impurities remain in the solution. The insoluble parts of the anodes fall on the inclined bottom K*a* and are collected in the flask *fa*. The lighter parts of the insoluble bodies are carried to the outside of the apparatus by the fluid and collected on a filter. The deposits that do not adhere to the cathodes fall on the inclined bottom *f* and are collected in the flask *fe*. The apparatus is said to possess the advantage that its operation is automatic and continuous; anodes and cathodes can be removed without interrupting the process and the losses in removing the products are reduced to a minimum. The compulsory circulation along the electrodes produces a uniform deposit and equal wear of the entire electrode surface. A number of these devices, which are constructed by H. Lacroix of Geneva, are in successful operation.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), January 14.*

THE IMPROVEMENT OF POWER-FACTOR IN ALTERNATING-CURRENT SYSTEMS.

This is an abstract of a paper read by Miles Walker before the Manchester Section of the Institution of Electrical Engineers on January 12. The author points out that as an average the power-factor on alternating-current systems at light loads is as low as 0.7 and at heavy loads not much over 0.8, and shows the decrease in the efficiency of the generators and the increased losses in mains occasioned thereby. Induction motors are the chief sources of low power-factor; arc lamps come next. Wherever a synchronous motor can have its power utilized the plan of using it to provide a leading current to compensate for the lagging current taken by other apparatus is a very good one, because the cost of giving to the synchronous motor sufficient capacity to enable it to yield a leading current is

comparatively small. Where rotary converters can be employed the power-factor can readily be maintained at unity, or the current even made leading. High-voltage condensers for improving power-factors have not been commercially employed, owing to their large cost. The reason that the induction motor acquires such a large wattless current is that its magnetizing current is supplied at high frequency. When, however, this is supplied in the rotor at the low frequency of the rotor circuit the wattless energy required is reduced to but two or three per cent of that required at the frequency of supply. The Leblanc and Heyland methods of producing leading currents were described. The author believes it possible to devise a new type of machine to act as an exciter somewhat like that proposed by Leblanc, but which can be produced at a much lower cost. Such a machine might be called a "phase advancer." When wound for three-phase its field magnet would have three, or a multiple of three, poles. The armature resembles somewhat the Thomson arc-light generator, except that it has a greater number of coils. On the commutator three brushes bear upon those segments connected to the coils which are for the moment passing under a pole. Each pole is provided with a compensating winding placed in slots in the pole-face. The effect of this winding is to equalize the current in all the wires passing under one pole. The electromotive force generated in any phase is due to the field which is produced by the current in the other two phases. By the use of an exciter in the rotor circuit it is possible to greatly increase the output of the motor frame. Without changing the construction of the stator its output is increased, since it may operate at unity power-factor instead of at lower value. A much greater gain in output can be secured by deepening the slots of both stator and rotor and putting in larger conductors. At present the depth of the slot is limited to keep down the leakage flux and the length of the saturated teeth, but when the exciting current is supplied to the rotor these considerations are not as important. The pull-out torque of an induction motor will be much increased by the use of a phase advancer, because not only can the working flux be kept up to full value, but it may be kept almost in phase with the stator currents. Another use for an exciter for the rotor is to change the speed of the motor. It may also be employed for exciting the rotor of an induction generator. By exciting the rotor of the latter with leading current the armature becomes capable of supplying a wattless current to help any synchronous generators in parallel with it. A matter that should be considered thoroughly by central-station engineers is the means which may be employed for inducing consumers to improve their power-factor. Present rates do not take account of this element. However, considering that the capital charges (especially for mains) form such a large proportion of the total cost of supplying electricity in comparison with the small proportion which the cost of coal bears to the total, it would seem to be fairer to charge the consumer by the kilovolt-ampere than by the kilowatt.—*Abstracted from the Electrical Review (London), February 5.*

ELECTRIC POWER FROM COKE-OVEN GAS PLANT.

The use of waste gas from blast furnaces and coke-oven plants has of late received considerable attention, but comparatively few plants have been put in. One of the strictly successful installations of this kind is at the Bargoed colliery of the Powell Duffryn Steam Coal Company, about fourteen miles from Cardiff, Wales. This plant has an output of about a million tons of coal per annum and requires a large amount of power for pumping, hoisting, ventilating, screening, etc. Practically all this is now secured as electric power from a gas-engine plant supplied by part of the waste gases from the coke ovens. Coal from a number of shafts is conveyed to the washery, where it is screened, and that which is less than five-sixteenths inch in size is sent to the coking plant. This washery has a capacity of 120 tons per hour and is driven by twelve three-phase motors, which operate the pumps, elevators, screens, washing boxes and conveyors. During the washing the coal which normally has an average ash content of twenty per cent has this reduced by the washing to six per cent. The coke ovens are of the Koppers type and are arranged in two batteries of fifty each on each side of a large coal-storage bunker. They are worked on the regenerative principle, fifty per cent of the gas produced being used in the oven flues, leaving the other fifty per cent available for power production. The ovens are charged from the top by small charging trucks which are filled at the bunkers. After the charge has been coked it is pushed through the oven by an electric ram and is conveyed by the plate conveyor to a screen. The output of each oven averages about 1,540 tons of coke per year. The gas produced is about 10,000 cubic feet per ton of coal and has a heat value of 400 to 440 British thermal units per cubic foot. The gas is passed through a cooling and purifying plant, consisting of scrubbers, coolers, water, tar and ammonia pumps, into a gas holder of 300,000 cubic feet capacity. The by-products formed during the purification (sulphuric acid and ammonia liquor) are converted into sulphate of ammonia, of which about five tons is formed per day. The power house contains at present two double-acting, four-cycle Nuremberg gas engines, one of 1,200 and the other of 2,400 horsepower, the latter being the largest gas engine in Great Britain. These engines are direct coupled to three-phase alternators supplying current at 3,300 volts and fifty cycles. Each set has its own direct-coupled exciter. The larger gas engine is a twin-tandem engine with the alternator between the two halves. The engines run at 100 revolutions per minute and have proven very efficient units. Duplicate electric ignition is provided at each end of each cylinder and supplied from two small batteries at seventy volts. The alternators are designed for an output of 825 and 1,650 kilowatts, respectively, at 0.75 power-factor. The switchboard equipment is very complete. It is built on the "carriage" individual cell plan, there being one panel for each generator feeder. These generating units run in parallel with a 750-kilowatt live-steam engine set and two 500-kilowatt exhaust-steam turbo-generators at an adjacent pit. The supply of electric power extends over the company's collieries throughout the Rhymney valley, about 170 motors being supplied, including eleven hoisting motors of fifty to 250 horsepower capacity. For clearing mines of water there are two 950-horsepower motor-driven centrifugal pumps, and three steam pumps of 200 horsepower are shortly to be installed. These pumps are to be run at night in order to utilize the gas power to the best advantage. The plant as a whole has run with such good results that another 2,400-horsepower gas engine will shortly be installed.—*Abstracted from the Electrical Review (London), January 22, 1909.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Westinghouse Storage-battery Regulating System.

The desirability of maintaining constant load upon the generating system of power installations is generally conceded by engineers. The recent rapid development of interurban railway lines operating a few cars, with relatively long intervals in their schedule, has imposed a very severe fluctuating load upon generating plants which furnish power for such systems. In some cases the average load does not equal twenty-five per cent of the maximum. With a load-factor as poor as this, it will readily be appreciated that the economy of such a plant will be exceedingly low, to say nothing of the increased investment due to large units lightly loaded. Such conditions are also arising in the case of single-phase electric roads and in industrial plants, where there is either heavy and intermittent hoisting or where there are very large motors driving machinery which is intermittently used.

As now manufactured, a storage battery in conjunction with an automatic regulating system forms an ideal solution of this problem. The storage battery acts as a reservoir to take up the surplus power when the external load is light, and to give out the power above the average when the load is heavy, thus maintaining a constant load upon the generating system. This is automatically effected by means of the regulator controlling the voltage of a generator, called a booster, which is in series with the battery. This regulator is controlled by the load conditions. The battery with the booster in series is usually placed across the line in parallel with the generator circuit, but between it and the load.

In case it is desired to regulate an alternating-current system, battery and booster are connected across the direct-current terminals of a rotary converter, and the battery is caused to charge and discharge by means of a regulator controlled from the alternating-current circuit. With this system, either alternating-current or direct-current circuits can be regulated simultaneously. In case only an alternating-current circuit is to be controlled, a boosted rotary can be used, and the booster thus be eliminated, using in its place a small exciter controlled by the regulator, to furnish current for the separately excited fields of the rotary.

It will be apparent from the foregoing that the success and efficiency of the whole proposition depends upon the regulator. The regulator must be sensitive, yet stable in its action. It must be reliable and simple to take care of, and it must be capable of permitting, quickly and easily, a wide range of adjustment of the generator load to take care of average load conditions. In other words, it is to the battery system what the governor is to a steam engine. All of these requirements have been more than met by a type of relay regulator used with great success by the storage-battery department of the Westinghouse Machine Company.

In Fig. 1 is shown the log of a battery and regulator test, producing a constant rotary load with a variable external load, at the plant of the Southern Colorado Power and Railway Company. This load is due to a railway system operated by the above company in Trinidad, Colo. The system comprises street railways in the city and an interurban railway running through mining towns for a distance of thirteen-and-one-half miles.

The company operates during light traffic three city cars and one interurban, and during heavy traffic five city cars and three interurban cars. During certain parts of the day one of the interurban cars is also used as a locomotive to haul standard fifty-ton coal cars. It will be noted that the average load runs about 100 kilowatts, while the maximum reaches upward of 400 kilowatts.

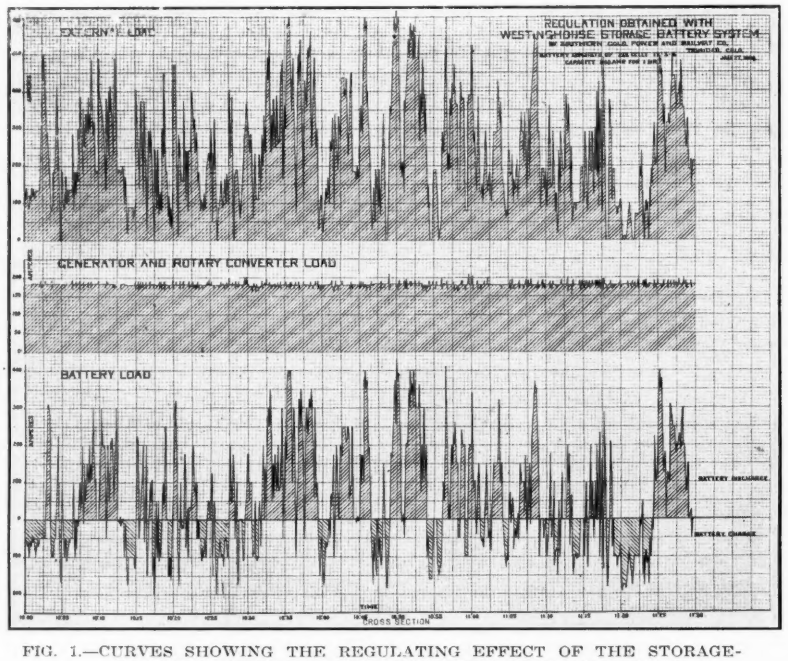


FIG. 1.—CURVES SHOWING THE REGULATING EFFECT OF THE STORAGE-BATTERY SYSTEM OF THE SOUTHERN COLORADO POWER AND RAILWAY COMPANY.

The generating plant consisted of one 200-kilowatt, 550-volt, direct-current generator direct-connected to a steam engine, three three-phase alternators similarly connected and of 105, 165 and 600 kilowatts, respectively, and a 250-kilowatt rotary converter, operating from the three-phase alternating-current circuit.

Before the installation of the storage battery and regulator it was necessary for a great part of the time to keep both the 200-kilowatt steam-driven unit and the rotary converter in operation. Since that time either one of the units is ample for

the entire direct-current load. Fig. 2 shows the switchboard with booster set at this installation.

In Fig. 3, with its reference letters, is shown the regulator, which can also be seen in Fig. 2. In this system of regulation the electromotive force of the booster, or boosted battery, as the case may be, is changed by changing the excitation of a single separately excited field winding. This receives its energy from a small exciter, which has, in addition to a self-excited shunt winding, two equal and opposite pilot field windings. The current in these two windings is controlled by the making and breaking of the double-relay contacts E, in Fig. 3. These contacts are in turn controlled by the primary relay of the regulator, which consists of a current member A working in conjunction with the potential member B to close or open the energizing circuit of the relay magnet D.

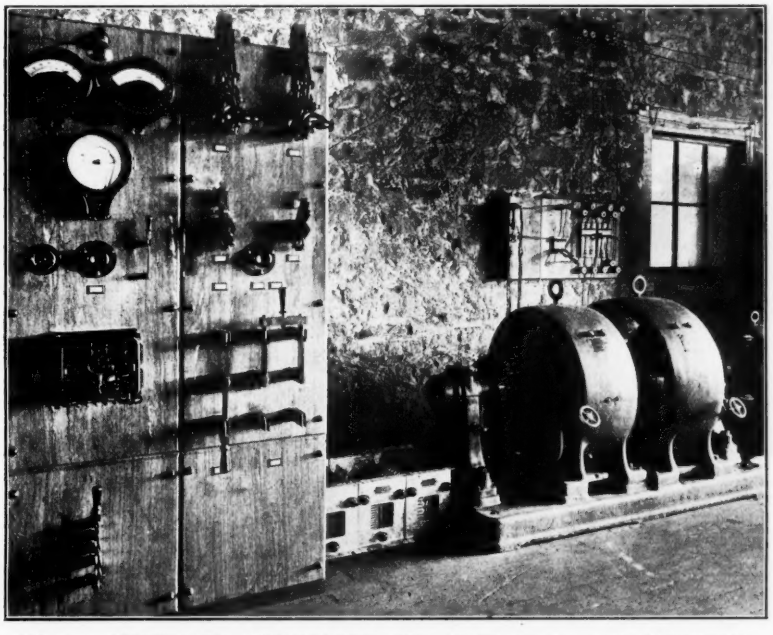


FIG. 2.—SWITCHBOARD AND BOOSTER SET AT PLANT OF THE SOUTHERN COLORADO POWER AND RAILWAY COMPANY.

The current coil A works in a permanent magnetic field, and is balanced by an adjustable spring tension. The amount of current flowing through this coil is proportional to the current flowing through a shunt in the circuit to be controlled, to the ends of which the terminals of the coil are connected. This is equivalent to an ordinary ammeter movement, with the exception that the range of motion is exceedingly small.

The voltage coil B is exactly equivalent, excepting that its position varies according to the voltage of the booster exciter.

The primary-relay contact C is established by the conjunction of the current and potential-coil levers. This contact, therefore, intermittently energizes the electromagnet D, which operates the main relay contacts E. The lower of these contacts energizes one of the pilot fields, while the other contact energizes the equal and opposite field. These pilot fields act in opposition, so that with the same amount of current flowing through both there would be no voltage upon the exciter.

If one of them received exciting current, it will tend to start up the exciter voltage in a given direction, but the shunt coil of the exciter will tend to carry the field to full saturation. This will be checked by the potential coil of the relay. It will thus be seen that, as the external load changes on the system, contact is broken, the booster voltage is raised, due to the exciter voltage rising, and the battery is caused to discharge. This discharge will continue at an increasing rate until the operating equilibrium of the system is again restored, and is entirely independent of the conditions of battery charge, or discharge, as long as there is enough booster pressure behind the battery to give the required discharge to maintain the load constant. Vice versa, if the load drops, the opposite effect is secured, namely, the other pilot coil tends to cause the exciter to build up in the opposite direction; this further is aided and carried to a maximum by the shunt coil, thus causing the battery to charge.

Practically no energy is handled by the regulator, since the voltage produced by the pilot coils is only twenty per cent of the total voltage of the exciter. Therefore, since the exciting energy of the booster will not be over eight per cent at a maximum, and the energy handled by the regulator will be a fraction of one per cent of the booster-field energy, the regulator operates with absolutely no sparking of the contacts, which means that there is practically no wear.

A five-step high resistance F is connected in series with the lead from the controlling shunt. This resistance is cut into or out of circuit by means of a handle of the rotary switch G. Thus, the effective drop across the current coil A can be varied by cutting in or out resistance, which will mean a greater or less current flowing through the shunt, in order to produce a given deflection of the current-coil arm, as the case may be.

The generator load will therefore be varied through five steps by shifting the switch G. The load can further be adjusted anywhere between these steps by changing the tension of the current-coil spring by means of the handle H. This covers the entire range of capacity of the generating system, so that the average load can be held anywhere from full load to ten per cent of full load.

Attention is particularly called in Fig. 1 to the closeness of the average load to a constant value. It does not slowly rise as the battery becomes further and further discharged, or drop off as the battery becomes charged. This effect, if desired, can be very easily secured by raising or lowering the sensibility weight I of the regulator. The momentary fluctuation, as shown by recording-ammeter curves, is well within the capacity of any ordinary flywheel of the driving engine.

The degree of regulation with this type of regulator is limited entirely by the speed of the booster, and does not depend in any way upon the regulator, as the speed of action of the regulator is far beyond the speed of magnetization of any commercial type of booster. A booster, of course, could be built to change its voltage with exceeding rapidity, but as the cost increases with the speed of magnetization, beyond a certain point such refinement of regulation is neither commercial nor necessary.

The true measure of the regulating quality of a regulator is the comparison

of the fluctuation of the average generator load taken into consideration with the maximum variation of the external load. For instance, a greater fluctuation of the generator load would be expected when the average generator load is only twenty-five per cent of the maximum external load, than when the average generator load is seventy-five per cent of the external load.

Bearing this in mind, the following table will be of interest:

Type of Regulator.	Westinghouse Long-Period.		Westinghouse Short-Period.	
Period.	1½ Hours.		80 Seconds.	
Source of Data.	So. Colo. Power & Railway Co., Jan. 22, 1908.		So. Colo. Power & Railway Co., Aug., 1907.	
	Amperes.	Per Cent.	Amperes.	Per Cent.
External load		...		...
Maximum	630	...	434	...
Minimum	0	...	14	...
Variation total	630	...	420	...
Generator load average	181	...	187	...
Maximum	210	...	194	...
Minimum	153	...	177	...
Variation total	57	...	17	...
Variation above avg.	29	16.0	7	3.8
Variation below avg.	28	15.5	10	5.5
External load variation:				
Maximum above average general load	449	248	247	132
Maximum below average general load	181	100	173	92.7
Per cent absorbed by battery regulator system		91	...	95.9
Maximum variation generator load, plus or minus average generator load, divided by maximum variation external load, plus or minus average generator load		6.46	...	4.13
Maximum variation in power output of generator, plus or minus average generator load		1.9	...	2.2

It will be seen by referring to this table that the maximum current fluctuation on the generating system, in the case of the test extending for one-and-one-half hours, is nine per cent of what the current fluctuation would have been if the battery and regulator had not been used, and is 4.1 per cent in the case of the short test. Furthermore, in the case of the long test, the energy fluctuation is 1.9 per cent of what it would have been if the regulator and battery had not been used, and is 2.2 per cent in the case of the short test. When it is taken into consideration that the maximum variation above the average generator is 248 per cent in the case of the long test and 132 per cent in the case of the short test, and the maximum variation of the external load below the average generator load is 100 per cent in the case of the long test and 92.7 per cent in the case of the short test the closeness of this regulation will be appreciated.

In the case of an alternating-current regulator in place of the direct-current coil A, the arm of which makes contact at C, a polyphase-wattmeter movement is substituted, the arm of which makes contact in the same manner. For controlling the average load the transformer ratio is changed by moving the handle G instead of cutting out resistance, as in the case of the direct-current regulation. In all other respects the two regulators are identical.

In conclusion, the advantages of this system of regulation are as follows:

1. Great efficiency, due to an inappreciable amount of energy being required to operate it.

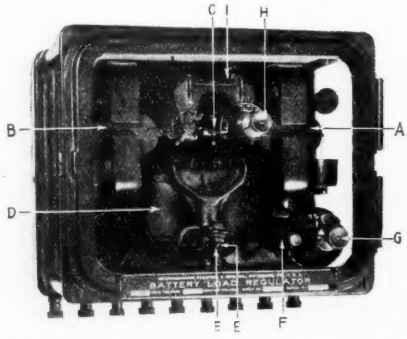


FIG. 3.—WESTINGHOUSE STORAGE-BATTERY REGULATOR.

2. Allows of adjustment of generator load over wide range while maintaining close regulation at all loads.

3. Holds the average generator load remarkably close to constant value irrespective of the condition of the battery as to state of charge or discharge.

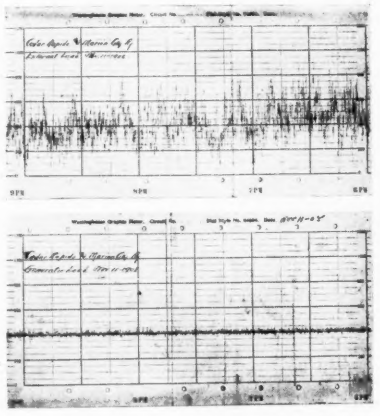


FIG. 4.—EXTERNAL AND GENERATOR LOAD CURVES.
Cedar Rapids & Marion City Railway Company.

4. Only two adjustments are necessary to effect any desired change in operating conditions: one to change average generator load, the other to limit the amount of battery charge or discharge. These changes are effected by simply turning one handle for each desired change.

5. The station bus-bar system does not require extensive alterations such as the insertion of energy-absorbing resistances or solenoids.

Fig. 4 shows load and generator curves taken by a Westinghouse graphic recording ammeter at the plant of the Cedar Rapids & Marion City Railway Company on November 11, 1908, the paper traveling through the ammeters at the rate of four inches per hour.

The Westinghouse storage battery is manufactured by the storage-battery department of the Westinghouse Machine Company. The Westinghouse storage-battery load regulator is made by the Westinghouse Electric and Manufacturing Company.

Physician Attaches Portable X-ray Outfit to Batteries of His Electric Automobile.

Dr. H. Threlkeld-Edwards, director of St. Luke's Hospital, South Bethlehem, Pa., is a gentleman of high professional attainment and many-sided culture, but among his different interests there are two that call out his keenest enthusiasm. One is his perfectly equipped X-ray laboratory; the other is the use for pleasure and professional duty of his electric automobile. Combining the two, he is now employing the storage battery of his automobile for operating his X-ray tube.

In a recent letter to the Waverly Company, Indianapolis, Ind., the manufacturer of his electric automobile, he writes in part: "I have tried out the plan and am putting it in daily operation. It works perfectly, and its simplicity makes it most available for general adoption. By this plan the medical profession can secure an automobile capable of running up hills and through mud (I do it every day, for this is a very hilly locality) at a cost of current consumption of about $5 per month (my December bill was $3.80) and at the same time secure an X-ray plant by an additional outlay of less than $150 that will do the work of a coil and rectifier, etc., costing over $500, and be able to take the apparatus wherever the car will go. My total outlay for the X-ray attachment is less than $130, including coil, condenser, interrupter, tube, stand and leads. I paid $750 for my office outfit running by alternating current."

Since this means provides an ever-ready portable X-ray outfit for the up-to-date physician and surgeon at a cost of less than $150, it seems that the doctor has made a useful discovery for the profession.

THE USE AND MANUFACTURE OF LEAD-COVERED CABLE.

BY C. F. DOHERTY.

Line construction is one of the chief problems of telephony. The remarkable growth of the telephone since the first few years of its existence, when lines were of common fence-wire strung from house-tops, barns and trees, has necessitated the introduction of new methods of line construction adapted to the changed conditions.

The stringing of exposed wires on poles with brackets, cross-arms, and glass insulators, worked well for a time, and under certain conditions is still practicable. But this method is not now considered advisable for lines of twenty or more two-wire circuits. As the number of lines increase, difficulties are encountered. The poles are overburdened by the addition of cross-arms, lines continually become crossed, and the wires, arms and even the poles are wrecked by wind and storm.

In order to have sufficient strength to withstand even ordinary weather conditions, copper wire must be of such size as to make it extremely expensive. Iron wire is not desirable for many localities, such as in the gas-laden atmosphere of cities or in the salty air of coast sections, because of its susceptibility to chemical action. Aside from the great expense of maintenance, such poor service is received that some sort of wire protection is imperative. For this protection the dry-core type of lead-covered cable is now most commonly used.

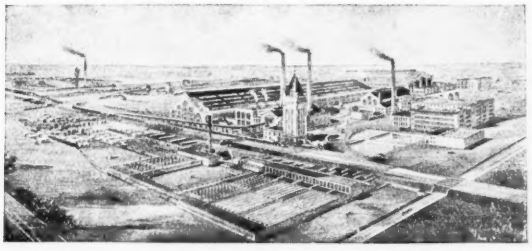
This cable may be strung on poles in the usual way, or it may be laid underground. The former method is chiefly employed in towns and in the smaller cities, but in larger cities the underground method is preferable, as poles are unsightly and take up valuable space.

The largest cable-manufacturing plant in the world is situated at Hawthorne, Ill., and is owned and operated by the Western Electric Company. This plant has a capacity of turning out 20,000,000 conductor-feet, or 3,488 conductor-miles of telephone cable per day. In this immense output of cable over twenty-four tons of copper and nearly seventy-three tons of lead are used.

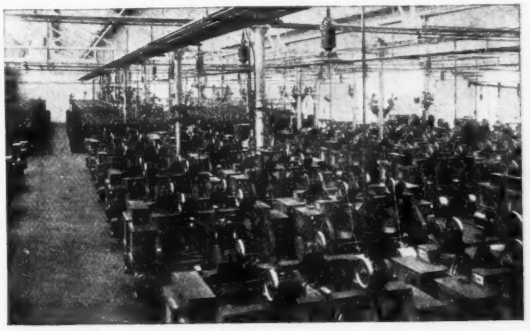
The advantage of such enormous facilities both to the manufacturer and to the consumer, is clearly apparent. By the purchase of raw materials in great quantities the lowest prices and the best qualities are secured. The use of highly specialized machinery, a perfect working system and the experience obtained in manufacturing on such a large scale, enables the highest grade of finished product to be placed on the market at a price equal to if not lower than that of a poor grade manufactured in small quantities. The dry-core type of lead-covered cable, having the conductors loosely insulated with paper, has almost entirely superseded the saturated-core type, having its conductors separately insulated and all impregnated with an insulating compound, because of its lower cost and better transmitting qualities. It has also been found that cable having its conductors insulated by a single wrapping of paper gives the most satisfactory results in all kinds of aerial and underground cable.

The raw materials used in the manufacture of Western Electric cable are delivered to the storerooms in carload lots, copper wire in the form of coils, lead in pigs and insulating paper in rolls. The insulating paper is of a special make and is manufactured expressly for the company.

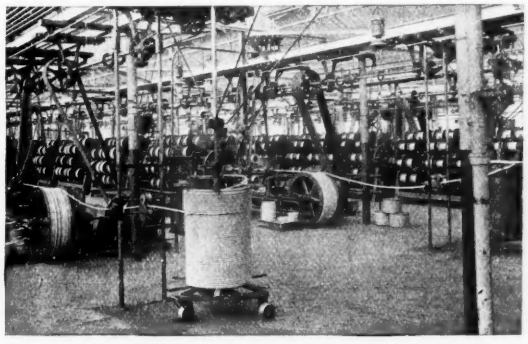
Each copper wire is separately insulated by a machine designed for the purpose. A roll of insulating paper is fastened to a head which is made to revolve. The copper wire as it is uncoiled from a stand on the floor, is led up over a pulley, through the center of the head and around a capstan. The revolving head winds the paper spirally around the wire. The insulated wire, continuing on, is then wound on a spool placed directly under the machine. Next, the insulated



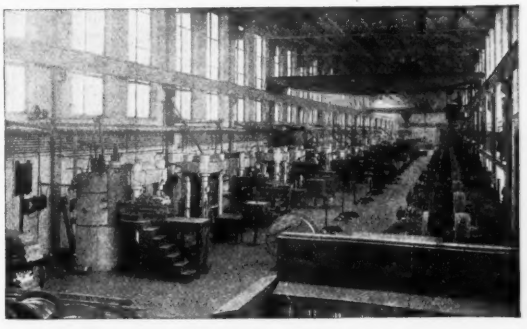
PLANT OF THE WESTERN ELECTRIC COMPANY AT HAWTHORNE, ILL.



INSULATING AND TWISTING ROOM, MANUFACTURE OF LEAD-COVERED CABLE.



STRANDING ROOM.



LEAD-PRESS ROOM.

wires are twisted in pairs. The insulating and twisting machines are individually operated by motors, thus doing away with all overhead shafting, pulleys, belts, etc.

The twisted pairs of conductors are then sent through the stranding machines and formed into core, which is made in sizes containing from five to 600 pairs. This machine is divided into sections called drums. To these sections or drums are fastened the spools upon which the twisted pairs are wound. As the drums revolve, these pairs are unwound from the spools, and, passing through a perforated iron disc attached to the drum and revolving with it, are stranded into the core in layers, each layer running diagonally across the one immediately within it. A sufficient number of spools are used on each drum to form a complete layer of core, and as many drums can be used as is desired, depending upon the number of pairs on the cable which is to be stranded. At each section is a button switch, which enables the whole machine to be stopped instantly from almost any point. During this process the stranded core is covered with a close spiral wrapping of two ribbons of insulating paper, each one overlapping the other. This wrapping is very strong, free from chemicals, and capable of withstanding intense heat.

After the core is formed, a test is given for the continuity of every wire in the cable, also a test for short-circuits and grounds. The cable is then wound automatically on an iron truck and thoroughly dried in an oven, usually from twenty-four to forty-eight hours.

The last process is that of encasing the core in its lead sheath, which merely serves to protect the conductors from mechanical injury and moisture. The lead of which this sheath is composed, contains a small quantity of tin which serves to give it the greatest resisting qualities with the least possible weight. In the case of submarine cable, the conductors are still further protected by a covering over the lead sheath, consisting of jute, galvanized-iron armor wire, and hemp treated with preservative and waterproof compounds. By means of the lead presses and hydraulic pumps the lead, being heated just enough to become plastic, is forced under great pressure into a die-block, through the middle of which the core is drawn, thus encasing the core in a seamless sheath of lead. A small portion of the sheath is forced through the die-block before the first end of the core appears, and this is bent in and closed up, in order to keep out the air. The last end of the cable is sealed in a similar manner. As the lead-sheathed cable comes out of the presses it passes over a trough of mirrors, thus enabling the workman to inspect the entire cable and to detect any possible flaws in the sheath. Finally the finished cable is reeled and lagged, and is then ready for shipment.

After every process in the course of construction, Western Electric Company's cables are subjected to exacting tests, securing their high insulation resistance and low capacity between conductors.

A Handy Electromagnet.

Something new in the lifting-magnet line has just been placed on the market by the Cutler-Hammer Clutch Company of Milwaukee, whose large lifting magnets are widely used in the iron and steel industries for handling pig iron, scrap, etc. The new device is a hand magnet

CUTLER-HAMMER ELECTROMAGNET USED IN HARDWARE STORE.

weighing only about seven pounds, but capable of lifting castings of from ten to fifteen times its own weight.

The magnet is designed for operation on 110-volt, direct-current circuits, and is furnished with a drop cord and attachment plug so that it may be readily attached to any ordinary lamp socket. The push-button, mounted on top of the magnet and operated by the thumb, closes the circuit to the coils and makes the magnet operative. On releasing the button the poles become demagnetized and the load is released.

The first of these little magnets was built for use in the Cutler-Hammer Clutch Company's own shop, where it proved so useful and attracted so much attention from visitors that it was decided to manufacture it in quantities for the market.

The magnet is capable of many useful applications. In machine shops it is used for clearing chips and borings out of the machinery or removing them from parts of the work not easily accessible, as, for instance, from the bottom of a deep cylindrical casting. Dropped tools, bolts, boring bars, etc., are easily recovered with the aid of the magnet, from places from which it would be difficult to fish them by ordinary means.

In shops where large quantities of brass and iron filings accumulate and which it is desirable to separate before selling as waste material, the magnet is especially useful, since brass, being of course non-magnetic, is not attracted by the magnet, like iron, thus enabling the two metals to be separated by merely passing the magnet through the mixed metals.

In foundries this magnet may be used to pick up hot or awkwardly shaped castings; smooth plates, on which it is sometimes difficult to secure a hold when lying on a flat surface, or for cleansing molding sand of minute particles of metal.

One purchaser, who uses several automobile trucks in his business, has put this magnet to a novel use. He is paving an alley in the rear of his store with ashes, and finding that many nails from packing boxes burned under the boilers are mixed with the ashes, he is now guarding against punctured tires by employing a magnet to remove nails from the ashes before strewing them in the alley.

In the shipping departments of large establishments many hundred nails are thus recovered daily from the sweepings. For work of this sort and for handling nails, nuts, screws, etc., in hardware stores the little magnet here illustrated should prove useful.

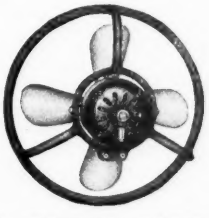
"Wireless" Antenna Struck by Lightning.

During an unusual electric storm at San Francisco on the morning of February 7, William J. Smith, western manager of the Massie Wireless Telephone Company, who was operating the company's instrument on the ocean front, was severely burned by an electric discharge that descended the mast into the station. The plant was put out of commission for several days.

General Electric Fans for 1909.

With the exception of a few slight changes, the fans placed on the market this year by the General Electric Company are identical with those of last season.

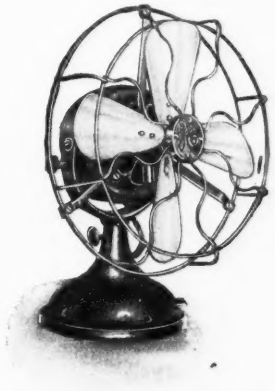
To its line of desk and bracket fans of last year a line of oscillating fans has been added. These fans, with the exception of the oscillating features, are identical with the corresponding fans of the standard types. These fans have a positive oscillating mechanism actuated by a worm on the armature shaft. This insures a uniform oscillating movement at all speeds at which the motor is designed to operate. The mechanism is so arranged as not to interfere with the convertible feature of the motor, by means of which it can be quickly adapted for either desk or wall use.



GENERAL ELECTRIC ALTERNATING-CURRENT VENTILATING FAN MOTOR.

Desk and oscillating fans, as usual, are furnished in all different types for standard voltages and frequencies, or can be wound to meet special requirements, if desired. Both direct and alternating-current fans of the desk or oscillating type can be obtained with twelve-inch or sixteen-inch blades. These, with the bracket-type fans of the same design and sizes, are available for all classes of service. An advantageous feature in connection with the direct-current desk motors is the universal joint with which they are equipped and by means of which a desk motor may be instantly transformed into one of the wall-bracket type, or vice versa, without the aid of tools.

The wall and desk types of the alternating-current fans are identical with the exception that the wall type has an angular adapter in addition to the standard parts of the desk type. This adapter enables the fan to be turned so as to utilize the breeze to the best advantage.



GENERAL ELECTRIC TWELVE-INCH DESK FAN.

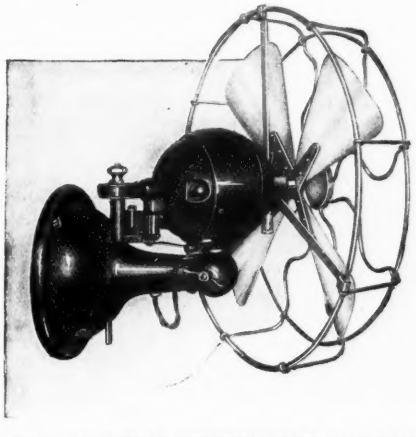
The ceiling and column fans are fitted with four wooden blades having a fifty-two-inch sweep for the alternating-current type and a fifty-eight-inch sweep for the direct-current type. The alternating-current fans are designed for operation on circuits of commercial voltages and for frequencies of sixty cycles or less. All ceiling and column fans are wired for two or four lights. These fans are specially suited for the cooling of large areas without producing disagreeable drafts.

Speed variations of the alternating-current fans are obtained by means of a regulating switch and reactive coil. A similar speed-controlling switch and an indestructible resistance enables various speeds to be obtained with the direct-current fans. The different speeds that may be obtained adapt the General Electric standard desk and oscillating fans to well-nigh universal application, since it may be operated on slow speeds for the office desk or home and on the higher speeds for stores and halls.

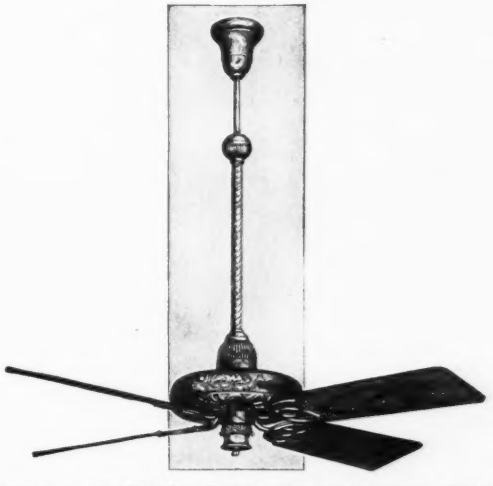
Both direct and alternating-current ventilating fan motors are manufactured with twelve or sixteen-inch blades. Speed controllers are furnished, however, only with the direct-current type. These fans are designed to be installed in the exhaust openings.

All the various types of fan motors which have been mentioned may be obtained in standard commercial sizes and for any commercial voltage and frequency. The standard finish for General Electric desk or oscillating fans is black enamel, with guard, blades and trimmings finished in dipped and lacquered brass. The frame of the plain type ceiling fans is finished in black enamel and the lower cover and trimmings in streaked oxidized copper. The ornamental types of ceiling and column fans are finished entirely or in part in streaked oxidized copper.

In the design of fan blades for the 1909 model motors, a departure from the conventional form is apparent. The usual design consists of a triangular-



GENERAL ELECTRIC SIXTEEN-INCH DIRECT-CURRENT WALL-BRACKET FAN.



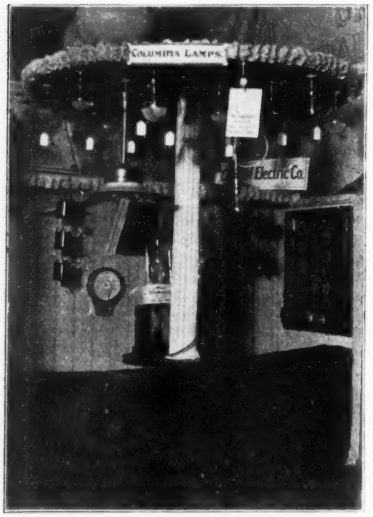
GENERAL ELECTRIC ALTERNATING-CURRENT CEILING FAN, FOUR-BLADE, FIFTY-TWO-INCH SWEEP.

shaped blade, with a constant pitch at all points and riveted to a narrow arm of the carrier. Blades of the new design are wider at the hub end than the ordinary blade and have a pitch increasing to a maximum at this point. The corners of the blades are also rounded off, and ample space is provided between the fan and the motor body. The blades are made of extra heavy brass, formed to shape under heavy pressure and riveted to a rigid spider. The result is a very rigid fan, that is entirely free from vibration and consequent noise.

The guards are heavy and durable and are supported in such a manner that it is impossible for them to shift or work loose. There is no solder used to hold the cross-wires. This construction gives a stiff and effective guard by which the motor can be lifted without danger of distorting or breaking any of the parts, thus providing a convenient method of handling the fan.

The Chicago Electrical Show Exhibit of the Columbia Incandescent Lamp Company.

The accompanying illustration gives a good view of the exhibit of the Columbia Incandescent Lamp Company at the recent Chicago Electrical Show. This company's fine line of incandescent lamps for every variety of service was shown by means of a large circular form, from which were suspended the various types of lamps, forming a part of the layout of the Central Electric Company.



THE EXHIBIT OF THE COLUMBIA INCANDESCENT LAMP COMPANY AT THE CHICAGO ELECTRICAL SHOW.

Meeting of Crocker-Wheeler Company Officers and Branch Managers.

At the annual convention at Ampere, N. J., February 8, of the officers and branch managers of the Crocker-Wheeler Company, the reports of the managers of the company's plants scattered over the whole country were uniformly optimistic on the business situation.

In their respective territories the Crocker-Wheeler men report brisk business in electrical machinery with manufacturers everywhere willing to consider the electrification of their plants or the installation of electric motors.

The Crocker-Wheeler convention dinner, attended by thirty-five men, took place in New York at the Machinery Club, in the Hudson Terminal Building, where the company has its New York offices.

Those who took part in the convention were: J. R. Wilson, W. C. Appleton, H. B. Hussey, R. N. C. Barnes, C. W. Startsman, J. B. Milliken, H. C. Petty, H. J. Sage, F. W. Kreps, S. Russell, Jr., Harold Lomas, J. M. Smith, M. E. Weissblatt, D. N. Force, Jr., Julian Roe, R. B. Treat, L. S. Horner, H. Pikler, C. N. Wheeler, H. A. Knoener, E. Heitmann, F. W. Young, A. Hartmann, B. A. Schroeder, Rodman Gilder, R. J. Randolph, Jr., H. L. Patteson, A. L. Doremus, Dr. Schuyler Skaats Wheeler, Gano Dunn, W. L. Brownell, F. B. DeGress and George W. Bower.

SESSION OF OFFICERS AND BRANCH MANAGERS AT THE CROCKER-WHEELER COMPANY'S OFFICES, AMPERE, N. J.

Connecticut Battery-Testing Meter.

Illustrated herewith is the new-type 1909 dead-beat battery-testing meter which the Connecticut Telephone and Electric Company, Meriden, Conn., has just placed on the market. As described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN last week, this instrument has many improvements over the older style. The new etched-metal dial now used adds to the accuracy of the instrument, which is made up on the dead-beat principle. As already noted, a new type of pointer construction has been added.

CONNECTICUT BATTERY-TESTING METER.

To Lease Chicago Elevated Roads.

Ira M. Cobbe, Samuel Insull and Emile K. Boisot have been appointed a committee to evolve a new plan to lease the South Side and Metropolitan Elevated roads, Chicago, to the Northwestern Elevated on a guarantee basis. It is stated that a straight consolidated plan has been found impracticable.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, FEBRUARY 6.—One of the new sections of the Paris Metropolitan will be very shortly opened for regular service. This section lies partly on the north and the south sides of the Seine, starting from Place d'Italie and ending at Place de la Nation. At this latter point it makes connection with two of the existing sections of subway, and under the square there is a very extensive underground station containing one complete loop and various side tracks. The new section runs upon an elevated structure for part of its course upon the south bank, reaching the elevated part after crossing the Seine upon the Bercy Bridge. Along the present line there are nine stations, part of them underground and part on the elevated structure.

The results of operating the Paris Metropolitan system for the last year have just been published in the official bulletin. Since April 21 the new Clignancourt-Chatelet section was put into service and the total length of the lines in the city is now thirty-five miles. The total number of passengers transported in 1908 is 229,700,519, against 194,823,282 in 1907, making an increase of 34,877,237. The traffic is divided as follows for 1908: First class (fare five cents), 26,276,783 passengers; second class (fare three cents), 150,658,277; employes' return tickets (four cents), 52,726,716; special collective tickets, 38,743 passengers. The employes' return tickets are delivered only before 9 a. m. The receipts of the company, after deducting the portion which is due to the city, are 26,671,168 francs, which is a good increase over last year's receipts, which were 22,813,536 francs. However, the increase is partly balanced by the increased operating expenses of the lines.

An electric tramway line is to be constructed from Chateaudun to the locality of Soucques, as the concession for the line has been granted by the general council of the Loir and Cher department to M. Lefebre, of Paris. The tramway line running from St. Didier to Mont d'Or, in the Rhone department, is to be put in regular service next spring. A. DE C.

GREAT BRITAIN.

(Special Correspondence.)

LONDON, FEBRUARY 5.—The attempt of the Bath Corporation to sell its electricity works to a company at a profit, which, as I pointed out at the time, was vetoed by the Board of Trade a few months ago, has now been abandoned owing to the refusal of the Board to modify its attitude in the matter. In doing so, the Board of Trade seems to have been actuated by feelings in the interests of the consumers rather than of the ratepayers, for the latter would have benefited by the transfer of the undertaking, which at present is hardly making a handsome profit. This decision will be valuable as a precedent, for there is a very general feeling among certain municipalities that it would be an easy matter to obtain from a company a larger sum for purchase than that represented by the actual capital expenditure.

Tube-railway enterprise in London at the present time is at a standstill so far as profits are concerned, compared with a year or two ago. The Great Northern & City Railway Company, which has the distinction—a rather expensive one—of being the only "tube" railway whose tunnels will take the main-line rolling stock, has not earned sufficient during the December half-year to meet its standing charges by $27,500. This particular railway suffers from the fact that it follows the route of one of the most important lines of electric tramway run by the London County Council in the north of London. The Central London tube railway shows a good result for the December half-year by virtue of the Franco-British exhibition, but the question of the proper system of fares is receiving the careful consideration of the directors in view of the acute competition carried on overhead by the motor omnibuses. The same remark applies to the Metropolitan Railway and the District Railways. Curiously enough, the tube railways affiliated to the District line, and inaugurated by the late Mr. Yerkes, show the most promise of any of the London tubes at present, mainly because they serve areas whose traffic arouses the least competition. The construction of a new tube railway has been begun from Euston to Watford. Euston is the terminus of the London & North-Western Railway, and the line is being constructed to develop a district which is rapidly becoming a place of residence of those engaged in the city. The railway will be partly in tunnel and partly on the surface.

In consequence of the amalgamation of what promised to be the two competing power companies on the Rand, the Victoria Falls Power Company will change its name to the Victoria Falls & Transvaal Power Company. The contract for the supply of fifteen of the Rand mines is to be put in hand at once, the necessary capital having been provided for.

Following the rejection of the idea of utilizing the trolley-omnibus system by the ratepayers of Liverpool and Manchester, comes the news that a deputation from the Sheffield Corporation has gone for a trip to the continent to inspect the installation which is working there. G.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, FEBRUARY 12.—At the annual meeeting of the Toronto Electric Light Company the president, Sir Henry Pellatt, announced that the past year had been the best in the company's history, and that the shareholders had nothing to fear from the threatened competition by a civic plant. The net profit amounted to $439,870, and a dividend of eight per cent was paid.

With a net surplus of nearly $500,000 in the bank, the financial statement read at the annual meeting of the shareholders of the Toronto Railway Company showed an increase of $103,284 in net earnings for the year. The railway carried 3,564,783 more passengers than the year previous. The ratio of operating expenses to gross earnings decreased one per cent

Hon. Walter Scott, premier of Saskatchewan Province, who has been in Ottawa, says that his government is proceeding differently, in respect to telephone construction, than did Manitoba and Alberta. The trunk lines are being built by the government and in the rural districts the formation of independent telephone companies is encouraged. The province furnishes the poles. Long-distance service and connection with long-distance lines outside the province will be under government ownership and operation.

The powers of the Board of Railway Commissioners for Canada have been extended, giving the board authority to compel one telephone company to connect with another, and the regulating of the price to be charged for such connection. Working agreements between companies are to be approved by the Board.

The annual report of the electric-light and power system of the city of Ottawa, owned and operated by the city, reveals a highly satisfactory condition of affairs. An increase of 140 per cent in the number of customers since the city took over the plant, and a net profit of $17,722 are the features of the report. Ottawa has now been operating its civic electric plant for a little over three years. Taken all around, it is shown that the rates charged by the Ottawa municipal plant for light and power are the lowest of any city in the Dominion, whether the plant be municipal or otherwise. The rates charged are subject to the approval of the Ontario Hydro-Electric Power Commission, from which the city purchases its power, and these rates cannot be changed without the consent and approval of the commission. W.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, FEBRUARY 12.—At the annual meeting of the Winnipeg Electric Company, held at Winnipeg February 10, William Mackenzie was re-elected president, William Whyte, vice-president, and F. Morton Morse secretary-treasurer. Wilford Phillips was also reappointed manager. A substantial increase of eighteen per cent in the net earnings of the company over 1907 was shown by the financial report. The gross profits for the year were $1,117,222.38, as compared with $946,675.76 the year previous.

The municipality of Birtle, Manitoba, is considering the installation of a telephone system. Address W. C. O'Keefe, Birtle, for information.

At the annual meeting of the Temiskaming Telephone Company, held at New Liskeard, Ontario, Thomas McCamus was elected president, George Wheeler, vice-president, and E. C. Kingswell, Arthur Freeland, Murdock McLeod, F. S. Brickenden and A. N. Morgan, directors. The financial statement of the company shows that the indebtedness is gradually being cleared off.

The Canadian Pacific Railroad has decided to install a telephone wire between Winnipeg and Brandon, Manitoba, a distance of 135 miles, for the operation of trains. There are twenty-eight stations and three junction points between these two places. Twenty trains run daily between the two cities.

A local syndicate at Portage la Prairie, Manitoba, is apply-

ing to the City Council for a franchise to distribute electric light, heat and power, and permission to erect poles along the streets. Address E. A. McPherson at Portage la Prairie for information.

The British Columbia Electric Street Railway Company, with head office at Vancouver, B. C., is considering a plan to build a loop line between Chilliwac and New Westminster to connect with the line now being built between those two cities. The company is also opening negotiations for the power at Stav Lake Falls and Vedder Falls. If the deal goes through this will be the longest electric railway in Canada. R. H. Sperling, Vancouver, B. C., is general superintendent of the company.

At the annual meeting of the Northwest Electric Company, Yorkton, Saskatchewan, J. M. Clark was elected president and T. A. Waterfield, vice-president. The secretary-treasurer has not yet been appointed, but E. M. Dumsford, formerly manager of the Bell Telephone Company at Carman, Man., has been appointed manager in place of Thomas Paul, resigned.

The Albertan government has announced the following reductions in telephone rates from Fort Saskatchewan: To Edmonton and Lamont, twenty-five per cent; to Mundare, thirty-five per cent, and to Chipman, Wetaskiwin and Lac St. Anne, forty-five per cent. This is the second reduction from the Bell rates made by the government since it took over the system. R.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

RUSK, OKLA.—The Rusk Telephone Company has been incorporated with a capital stock of $10,000. P.

GEARY, OKLA.—The Alfalfa Telephone Company has been incorporated with a capital stock of $1,000. P.

CACHE, OKLA.—The Wichita Telephone Company has been incorporated with a capital stock of $2,000. P.

KEYSTONE, OKLA.—The Keystone Telephone Company has been incorporated with a capital stock of $400.

HERSHEY, NEB.—The Hershey Telephone Company has been incorporated with a capital stock of $5,000. P.

WEBSTER, S. D.—The Ekalaka Telephone Company has been incorporated with a capital stock of $10,000. P.

ARTESIA, N. M.—The Artesia Plains Telephone Company has been incorporated with a capital stock of $10,000.

WEST PLAINFIELD, WIS.—The farmers of Portage County will build a telephone line from Bancroft to Grand Rapids.

PORT LAVACA, TEX.—The Port Lavaca Telephone Company has been incorporated with a capital stock of $20,000. P.

STANTON, NEB.—The Stanton Independent Telephone Company has been incorporated with a capital stock of $15,000. P.

BROWNS VALLEY, MINN.—N. J. Brown and others have organized a telephone company with a capital stock of $50,000.

BUFFALO, OKLA.—The Harper County Mutual Telephone Company has been incorporated with a capital stock of $3,000. P.

GRACEVILLE, MINN.—L. J. Keating and others have organized a telephone company and will build an exchange in the near future.

PERHAM, MINN.—The Perham Rural Telephone Company has been incorporated and will construct lines in the vicinity of Perham.

FRONT ROYAL, VA.—The Liberty Corner Mutual Telephone Company was incorporated with $5,000 capital. R. J. Stokes is president.

PINE RIVER, MINN.—The Pine River Rural Telephone Company has been incorporated with $10,000 capital and will erect an exchange. C.

CARLISLE, PA.—A rural telephone company of the Home line has been organized in Walnut Bottom by electing H. J. Brinkerho president, and W. S. Thumma, secretary.

MISSOULA, MONT.—The Montana Independent Telephone Company is planning to install an automatic exchange. A petition is before the City Council for the use of the streets. C.

DAYTON, IOWA—At the annual meeting of the Dayton Mutual Telephone Company John W. Green was elected president; Conrad Johnson, vice-president; Carl Will, secretary; E. M. Lundien, treasurer. C.

OMAHA, NEB.—The American Telephone and Telegraph Company of Nebraska has been incorporated for $200,000, with Charles R. Bangs, president; Charles D. Cole, vice-president; Melville Engleston, secretary; James C. Vail, treasurer. C.

DES MOINES, IOWA—A bill to require competing telephone companies to make connections between each other's subscribers for a nominal fee is the measure on which Senators Adams and Moon and Representative Davidson are now working in the Iowa Legislature.

SHELBURN, IND.—The Central Mutual Telephone Company has been incorporated to build and equip a telephone system in Shelburn and Sullivan counties. P. T. Lloyd is president and H. V. Stark, secretary.

MEXICO CITY, MEXICO—At a special meeting of stockholders of the Mexican Telegraph Company an increase in the stock from $3,000,000 to $5,000,000 was authorized, the issuance of the stock being left to the discretion of the directors.

BURNS, ORE.—Articles of incorporation have been filed by the Eastern Oregon Telephone and Telegraph Company, with J. R. Jenkins, J. H. Jordan and E. T. Jenkins as incorporators. The principal office is at Burns, and the capital stock is $10.000.

ROCKDALE, IND.—The Johnson Fork Telephone Company of Rockdale has been incorporated to build a telephone exchange in Rockdale and throughout Franklin and Dearborn counties. H. G. Larue, Albert Metter, J. D. Gold and Frank Gurr are directors. S.

JAMESTOWN, N. D.—The Wright-Allen Telephone Company has been formed to construct a telephone line from Jamestown south ten miles to S. F. Corwin's farm. The officers of the company are S. F. Corwin, president; Steve Allen, treasurer, and James Wright, secretary.

SAN FRANCISCO, CAL.—The Oceanic Steamship Company has closed a contract with the United Wireless Telegraph Company for installing wireless plants on its steamers Mariposa and Alameda. The work is to be done on the next arrival of the steamers at San Francisco. A.

HUDSON, N. Y.—The Valatie Telephone Company is planning for an extension of its telephone system. It is proposed to build a line from Valatie to West Ghent and other localities, and the company also contemplates the establishment of a telephone exchange at Stuyvesant.

OSKALOOSA, IOWA—The Oskaloosa Home Telephone Company plant has been sold to H. H. Sheriff, an attorney and capitalist at Oskaloosa, for $200,000. The company had erected a new building, put in a new switchboard, and the plant is considered one of the best equipped in Iowa.

ST. PAUL, MINN.—Bills have been introduced into the Minnesota Legislature giving telephone companies the right to use the poles and cross-arms erected by any other company along any public thoroughfare and also increasing the gross earnings tax of telephone companies from three to four per cent. C.

CHESANING, MICH.—The Chesaning Home Telephone Company, organized among the business men of the town, has taken possession of the Chesaning exchange of the Bell Telephone Company. The deal includes the switchboard and all fixtures, poles, wires and telephones, with the exception of the toll lines. The consideration was $9,000.

ST. PAUL, MINN.—A bill is proposed in the Minnesota Legislature by Senator McGowan of Minneapolis to require competing telephone companies to give connection with other lines. The state university at Minneapolis has sought to secure this service by means of an individual switchboard, but both companies refused connection and the bill is probably an outgrowth of this refusal. C.

EDMONTON, ALBERTA, CANADA—The annual report of the Alberta government telephones shows a total circuit mileage of 1,842; total long-distance, 1,427; rural telephones, 563; toll stations, 150; number of exchanges, 45, having long-distance connections. The total initial capacity of the exchanges is 6,191. Revenue to December 31 amounted to $137,118, and the total expenditures $1,380,219.

COLUSA, CAL.—The Colusa County Telephone Company of Colusa has completed the purchase of the Pacific Telephone and Telegraph Company's local systems in the county at a cost of $15,000. The two systems heretofore in operation will be merged. Under the terms of the transfer the long-distance business of the new company will be handled over the lines of the Pacific Telephone and Telegraph Company. A.

SALEM, ORE.—In the case of the State of Oregon against the Pacific Telephone and Telegraph Company, the state Supreme Court has upheld the constitutionality of the law, enacted by popular referendum in 1906, requiring the company to pay an annual license tax of two per cent on its gross receipts and to make annual statements to the state treasurer. It is anticipated that the case will be appealed to the United States Supreme Court.

WASHINGTON, D. C.—The House Committee on Merchant Marine and Fisheries has reported favorably the Burke bill, which provides a penalty of $3,000 or one year's imprisonment, or both, for the failure of any ocean craft carrying fifty or more passengers and going 200 or more miles to have a wireless equipment and an operator. The bill makes no provision for the great lakes, and a fight in this direction is expected in the House. The application of the proposed law to the lakes was urged at the hearings, but it was declared that the shores of the lakes are not provided with wireless stations.

ELECTRIC LIGHTING.

(Special Correspondence.)

WHITEFISH, MONT.—An electric-light system has been established at Whitefish. C.

MIZPAH, MINN.—W. A. Potter has been granted an electric-light franchise at Mizpah. P.

VERNON, TEX.—The Vernon Light and Power Company is about to install a plant at Vernon. P.

NEW SALEM, N. D.—Business men propose to install an electric-light plant at New Salem. C.

HIBBING, MINN.—A. P. Silliman is installing a light and water plant in the Brooklyn addition. C.

ANADARKO, OKLA.—The city of Anadarko has voted $14,000 in bonds for an electric-light plant. P.

SHANNON CITY, IOWA—The establishment of an electric-lighting plant is projected at Shannon City. C.

FLATONIA, TEX.—The electric-lighting plant of F. A. Ziegelbauer has been destroyed by fire. Loss, $30,000. P.

FERGUS FALLS, MINN.—The electric-light commission has ordered fifteen more arc lights for the streets. C.

CARTHAGE, TEX.—The Carthage Ice and Electric Company has been incorporated with a capital stock of $20,000. P.

TAYLOR, TEX.—The Citizens Light and Power Company has increased its capital stock from $10,000 to $20,000. P.

TUCUMCARI, N. M.—The Tucumcari Water and Light Company has been incorporated with a capital of $100,000. P.

PRESCOTT, ARIZ.—M. J. Hickey, Robert Brow and H. T. Andrews have been granted an electric-light franchise. A.

BRIDGER, MONT.—Minneapolis capitalists are considering the erection of power plants on the Bluewater, near Bridger and Fromberg. C.

LAUREL, MONT.—As soon as a franchise is granted the Billings and Eastern Montana Power Company of Billings will install street lights. C.

SAN DIEGO, CAL.—P. J. Schaniel and A. N. Jones have been awarded a franchise to erect a wave-motor plant at the entrance of False Bay.

SONORA, CAL.—The Tuolumne Water Power Company has been granted a franchise for an electric transmission line on public highways of the county. A.

SANFORD, N. C.—The Sanford cotton mills will be operated by electricity from a new development at Buckhorn Falls on the Cape Fear River, after the middle of April. L.

SAN DIEGO, CAL.—The City Council has advertised for bids for laying conduits for the proposed ornamental lighting of D Street from Eighth to California streets. A.

BEND, ORE.—J. G. McGuffie and others of this place have organized a company to build a power plant at Cline Falls to furnish light and power to Redmond and vicinity. A.

MILLVILLE, MINN.—S. D. Pierce and Edward Dickman are considering the damming of the Zumbro River for the operation of electric-light systems and trolley lines. C.

WASHINGTON, IND.—The City Council has put on the market $20,000 in four-per-cent bonds to improve the municipal lighting plant and provide money for running expenses. S.

ST. PAUL, MINN.—An ordinance introduced into the assembly fixes the charge for electric lights at 12.6 per kilowatt-hour for the first sixty hours' use and 6.3 cents per kilowatt-hour thereafter. C.

SPENCER, IND.—Andrew McGuire, engineer, was seriously injured, and W. F. Gould, manager, slightly injured in an explosion that wrecked one side of the electric-light and water plant at Spencer.

FAIRMONT, W. VA.—The Independent Light and Power Company has asked the Council for a franchise to operate in the city. The plant is to be in operation seventeen months after the granting of the franchise.

MINERAL WELLS, TEX.—The Beardsley interests, consisting of an electric-light and power plant and a street railway, have been sold at auction to D. T. Bomar of Fort Worth for $75,000. The total valuation of the property is about $175,000.

PHILIPSBURG, MONT.—The City Council has let a contract for lighting the streets for three years to Bowen Brothers, who have leased the plant of the Philipsburg Granite Electric Light Company, which they will repair and improve. C.

COLORADO SPRINGS, COLO.—To accommodate the Printers' Home and the new Protestant hospital in the east end of the city, the Colorado Springs & Interurban Railroad Company will construct new lines at a cost of $30,000 this spring.

STEPHENSON, MICH.—With $15,000 as the consideration, the Electric Light and Power Company, of Iron Mountain, has purchased the lower Twin Falls, on the Michigan side of the Menominee River, and will proceed with their development.

SANTA MONICA, CAL.—The City Council has ordered all telephones and electric-light poles removed from the streets and all electric wires to be placed under ground along the Speedway from Hollister Avenue to the southern limits of the city. A.

DEFIANCE, O.—The plant of the People's Gas and Electric Company, which has been financially involved, will be sold either by the sheriff or the present receiver, F. L. Hay, according to an arrangement which is said to be satisfactory to all parties. H.

TOLEDO, O.—The trustees of Washington township will advertise for bids for lighting West Toledo by electricity. The petitions which have been in circulation have been returned with the signatures of practically every resident of West Toledo. H.

LOS ANGELES, CAL.—At the special election held February 1 the charter amendment designed to prevent the electric power generated along the Owen's River aqueduct from passing into the hands of private parties was carried by a small majority. A.

LEWISTON, IDA.—W. H. Burke and associates of Spokane, Wash., have been granted the electric-lighting franchise in Lewiston petitioned for a few weeks ago. Work is to begin in nine months and the system is to be in operation by February, 1911.

BROCKVILLE, CANADA—W. M. Beach, proprietor of an extensive waterpower at Iroquois, Ontario, has made an offer to manufacturers in the city of Brockville to transmit 1,000 horsepower at a reasonable cost and will construct his own transmission lines. W.

FRESNO, CAL.—Manager A. G. Wishon, of the San Joaquin Light and Power Company, states that it has been decided to extend the company's power-transmission lines to the towns of Sanger, Clovis, Pollasky, Malaga, Sultana, Orosi, Parlier, Lemoore and probably Conejo. A.

TILTON, N. H.—The Tilton Electrical Company has begun the installation of a new power station, at what is known as the lower dam, where a 100-kilowatt dynamo is to be placed in readiness for use in case of trouble at either of the other two power stations of the company.

MEMPHIS, TENN.—The Memphis Consolidated Gas and Electric Company has contracted with the Allis-Chalmers Company for two 1,500 kilowatt steam turbines for immediate delivery. The total capacity of the plant will be thus brought up to approximately 8,500 kilowatts.

LAFAYETTE, IND.—The Fort Wayne & Wabash Valley Traction Company is moving a part of the equipment of its power house at Huntington to this city and installing it in a new addition now being built to the power house in this city to extend the lighting facilities of the plant. S.

SMITHFIELD, N. C.—The Ivanhoe Manufacturing Company has been chartered at Smithfield, with a capitalization of $300,000, by W. M. Sanders, of Smithfield, and ten associates, to build a cotton-mill and to generate and distribute electricity, with the right also to build and operate electric railways. L.

LANSING, MICH.—The Supreme Court, in the case of the Bay City Traction and Electric Company, has affirmed and made permanent the injunction of the lower court restraining the city from establishing a commercial lighting plant on the ground that its present charter gives it no authority to do so.

MINNEAPOLIS, MINN.—Unless the General Electric Company introduces electric lights into Linden Mills, a suburb of Minneapolis, the residents will install their own plant. Truman J. Hibbard heads a committee to confer with the City Council in regard to obtaining a special franchise for the purpose. C.

FORT WAYNE, IND.—The Fort Wayne and Wabash Valley Traction Company is determined not to yield the field to the municipal lighting plant for commercial lighting, and has secured the contract for lighting the Elks Temple at a flat rate of two cents a kilowatt-hour, against four cents bid by the city plant. S.

NEW YORK, N. Y.—The Edison lighting companies in New York and Brooklyn are reported to have announced that they would defy the recent order of the Public Service Commission directing them to publish a fixed rate of tariffs, and forbidding discrimination being shown to any consumer. Legal action will be taken.

MILWAUKEE, WIS.—The Chicago & Milwaukee Electric Railway Company, through its attorneys, has filed a protest with the Wisconsin state railroad commission protesting against the granting of a certificate of necessity and convenience to the Chicago, Kenosha & Milwaukee Electric Railway Company. The

Northwestern Railway also will make a protest. The proposed road will exactly parallel the Northwestern and the Chicago & Milwaukee Electric between Chicago and Milwaukee.

LAURINBURG, N. C.—The Laurinburg electric-light plant recently doubled its capacity to meet the increased demand for power. L.

NORTH YAKIMA, WASH.—The Spalding Company, of which H. B. Spalding is president, is to erect a 300-horsepower hydroelectric plant to furnish power for pumping plants. A.

NORTH WILKESBORO, N. C.—The town of North Wilkesboro has purchased from J. G. and R. N. Hackett a waterpower electric plant, paying the sum of $23,000. The plant includes an excellent waterpower, from which the city now derives electricity for lighting. L.

ST. PAUL, MINN.—The Northwestern Electric Equipment Company has secured the contract for 250,000 electric lamps for the administration building of the Studebaker Brothers' Manufacturing Company at South Bend, Ind., to cost $40,000, and also a contract to furnish a New York street-car company with 1,000,000 lamps. C.

MEXICO CITY, MEXICO—The Mexican Light and Power Company has completed plans for increasing the capacity of its Necaxa plant from 50,000 horsepower to 124,000 horsepower. Of this 42,000 horsepower will be added at once. The change will involve the installation of four new generators and the building of about 18.5 miles of canals and tunnels. A.

SALT LAKE, UTAH—The Utah Light and Railway Company will shortly order a 3,000-horsepower motor-generator at a cost of about $35,000, this being a duplicate of one just installed. Plans are also under way for a steam emergency plant to be erected on the Jordan River to have capacity of one-half of the total demand made on the present plant. A.

RENO, NEV.—Tasker L. Oddie and Sam Musser, representing a Chicago syndicate, have purchased from J. M. Dixon water rights on the Kings River. It is the purpose of the syndicate to construct a $9,000,000 power plant to develop 250,000 horsepower. Lines will be dropped down the western slope of the Sierras to Bakersfield, and strung up and down the San Joaquin Valley.

ELIZABETH, N. J.—The Board of Freeholders has decided to install an elevator in the courthouse at a cost not exceeding $3,500, and has authorized the Public Grounds and Buildings Committee to consider the advisability of building its own electric-light plant to be used in lighting the county buildings. The probable cost of the latter is to be reported at a future meeting.

MIDDLETOWN, CONN.—The Middletown Electric Light Company has decided not to erect its proposed plans this year and has come to an agreement with the Glastonbury Power Company on the supply of power. The Glastonbury company controls the valuable waterpower privileges in the Cotton Hollow region of South Glastonbury and will shortly erect a large generating plant there.

TORRINGTON, CONN.—At the annual meeting of the stockholders of the Torrington Electric Light Company it was voted to increase the capital stock of the company from $300,000 to $450,000, to provide for the enlargement of the plant and the increase of generating capacity to meet the rapidly-increasing demands. It is probable that the company will also erect an office building. The old board of officers was re-elected.

MILLEDGEVILLE, GA.—A new company has been incorporated in Milledgeville to furnish electric light and power. The new interests purchased the old power plant and are adding new buildings and machinery, with a capacity of 500 horsepower. Machinery will also be installed in the Oconee River mills by which waterpower will be utilized to furnish the necessary power, although an auxiliary steam plant will be retained. L.

ATLANTA, GA.—Judge Newman, in the federal court, has sustained the report of the special master, George D. Anderson, in the case of the Georgia Manufacturing and Public Service Corporation, Marietta, Ga., and has adjudged the concern bankrupt. A petition for a receiver was filed in August, 1908. The company based its objection to the receivership on the grounds that it was principally engaged in furnishing lights to the town of Marietta, whereas the special master found that the manufacture of paper was the principal business of the company. L.

CHARLOTTE, N. C.—The Charlotte Electric Railway, Light and Power Company has effected a division of the power and lighting systems and the street-railway systems, for the better management of the business, and the lighting and power interests have been incorporated with $300,000 capital as the Charlotte Gas and Electric Company. The president of both departments is E. D. Latta. The company has for several years contemplated the extension of its lines to the Catawba River, twelve miles distant. The division of the business is also accompanied by the provision for a large increase in capitalization whenever such is deemed necessary. The company this winter is expending about $100,000 in local improvements on its lines. L.

REIDSVILLE, N. C.—An electrical development in the north central part of North Carolina, on Deep River, in Moore County, is being planned, and it is not improbable that electric power will be secured for distribution at Reidsville and Greensboro, the power being transmitted about sixty-five miles from the proposed hydroelectric plant. Engineers have reported that within eight months a minimum of 4,000 horsepower could be delivered at Greensboro, and the prospects are for the early organization of a company to carry out the development on Deep River, distributing the power throughout the nearby towns. L.

NEW ORLEANS, LA.—The Hibernia Bank and Trust Company has exercised its option in concluding the deal with the New Orleans Railway and Light Company, by which the latter sells $2,400,000 of four-and-one-half per cent bonds. The option price was seventy-five. Meanwhile the bonds have sold in the open market at seventy-eight and one-fourth. President John J. Gannon of the Hibernia Bank states that these securities will be marketed outside of New Orleans. The bonds were placed as collateral for a $2,000,000 cash loan on June 20, 1908, by means of which the company issuing them took up its floating indebtedness.

TOLEDO, O.—The City Council has repealed the legislation providing for a municipal lighting plant, and the board of public service has dismissed court proceedings against the Ohio Electric Railway Company. By the terms of the new ten-year contract for lighting at Lima arc lamps will cost but $57.50, as against $85 heretofore, and nine months of the old contract is thrown off, making a saving to the city of about $10,000. Commercial lighting has been reduced from twelve cents to eight-and-one-half cents per kilowatt-hour, with a five-per-cent discount if paid before the tenth of the month. Free lights will be furnished for certain public buildings and a flat rate of five cents is made to the public schools, library and hospital. H.

SPOKANE, WASH.—A number of improvements will be made by the Washington Water Power Company of Spokane during the present year. It is given out that $750,000 will be spent on the company's power plant at Little Falls, two 1,500-kilowatt motor-generator sets will be installed at the steam power station, a substation and motor-generator station will be built at Cheney, two 3,000-horsepower transformers will be installed at the Twentieth Avenue station and minor additions will be made at the substation at Post Falls. On the company's interurban electric-railway lines some new substations will be erected. A.

OROVILLE, CAL.—Secretary H. P. Wilson of the Great Western Power Company states that the work of doubling the present capacity of the electric plant at Big Bend, near Oroville, will be undertaken in the spring. The capacity will be increased to 144,000 horsepower. Construction work will also begin this spring on the dam that will convert Big Meadows, which is high up in the Sierras, into a reservoir. The company owns a reservoir site of 20,000 acres, where water will be stored in the winter for use during the dry season. Secretary Wilson announces that $5,000,000 will be spent on the new works. During the storms of the past month a number of the steel towers which were being erected to convey the distributing wires were thrown down. A.

NEW PUBLICATIONS.

MINERAL RESOURCES OF THE UNITED STATES, 1907—The United States Geological Survey has completed its final reports on the "Mineral Resources of the United States, Calendar Year 1907." Volume I has 742 pages, and is devoted to metallic products; volume II has 897 pages, devoted to the non-metallic products. Extracts from advance sections of these reports have appeared in these columns from time to time.

PROGRESS IN ELECTRO-METALLURGY—This account of the electro-metallurgical industries by John B. Kershaw has been reprinted from the Smithsonian Report for 1907. The processes described include all the manufactures of this class carried on upon a large scale in this country, including the production of aluminum, bullion, calcium carbide, carborundum, copper, diamantine, graphite, ferro-alloys, iron and steel, lead, silicon, sodium, tin and zinc.

OPERATING RULES AND REGULATIONS FOR TELEPHONE OPERATORS—T. Anne Barnes, chief operator for the Interstate Telephone Company, Springfield, Ill., has arranged a pamphlet of thirty-four pages treating in a comprehensive manner the duties of local and long-distance telephone operators, which also discusses the rules and regulations of the operating room, methods of handling trouble records, toll tickets, etc., and defines the responsibilities of chief operators assistants and desk clerks. The booklet is for sale by the Western Telephone Journal Company, Vinton, Iowa. Price, fifty cents.

TESTS OF COAL AND BRIQUETTES AS FUEL FOR HOUSE-HEATING BOILERS—In carrying out its general plan

of determining more efficient and more economical methods of utilizing the fuel resources of the United States, the United States Geological Survey has made a series of experiments on the combustion of fuel in house-heating boilers. As it was realized that steam boilers of the ordinary types used for heating private houses are often installed and operated under conditions unfavorable to fuel economy and smoke prevention, these experiments were made with briquets, raw coal and washed coal, so as to determine what is to be expected of these fuels in a representative house-heating plant, properly installed and operated. The series of tests from which the present report is drawn, was carried out at the University of Illinois experiment station by D. T. Randall of the United States Geological Survey.

THE PURDUE ENGINEERING REVIEW FOR 1909.—The 1909 number of the *Purdue Engineering Review*, the publication of the engineering societies of Purdue University, will be issued early in March. It will contain, among thirty contributed articles by alumni and faculty, the following representative papers of special interest: "Neutralizing Transformers for Telephone Lines Paralleling Single-phase Railways," by J. H. Cannon, '07; "The Overhead Equipment of the Three-phase Electrification of Trunk Lines," by F. S. Denneen, '03; "An Unusual Hoisting Equipment in a Mexican Mining Camp," by W. M. Hoen, '03; "Central-station Meter Department Problems," by E. A. Le Fevre, '01; "The Rehabilitation of the Street-railway System of Chicago," by F. E. Morrow, '04. J. L. Bradfield is editor-in-chief, E. W. Beckman is business manager and O. G. Taylor is distribution manager for the 1909 publication. The price of the *Engineering Review* is fifty cents.

PERSONAL MENTION.

MR. R. B. JENNINGS has resigned as city electrical inspector of Duluth, Minn. C.

MR. ROBERT McCULLOUGH has been elected president of the United Railways of St. Louis, Mo. The other officers were re-elected.

MR. ARTHUR MANN, for several years chief electrician for the Evansville Electric Railway, has become assistant superintendent of the Michigan United Railways Company. S.

COMMISSIONERS JOHN E. EUSTIS and JAMES E. SAGUE have been renominated by Governor Hughes to fill their positions in the Public Service Commissions of the First and Second districts, respectively.

MR. WILLARD J. HIELD, general manager of the Twin City Rapid Transit Company, will be elected vice-president of the company, succeeding C. G. Goodrich, who will become president. Mr. Hield has been in the employ of the company for twenty-one years. C.

MR. ROBERT A. DYER, JR., of Auburn, N. Y., has been elevated to the position of assistant general manager of all the Beebe trolley roads. For some time he has been assistant general manager of the Rochester, Syracuse & Eastern and the Auburn & Syracuse roads.

MR. CHARLES G. LOUGHMAN, former superintendent of the Chicago, South Bend & Northern Indiana Traction Company, has been appointed assistant general manager of the Buffalo & Erie Traction Company, with headquarters at Erie, Pa. Mr. Loughman will have charge of the western division of the 200-mile system. S.

MR. LOUIS SIMPSON has resigned the management of the Montreal (Canada) Cotton Company works to devote the rest of his career to the electric smelting industry. He has acquired the control for this continent of the patent processes recently perfected in Sweden partly as a result of the experimental work done in Canada. As a branch of electric-smelting manufactures, Mr. Simpson proposes to dispose of the sulphuric acid, which is an extensive by-product of the process, by producing superphosphate manures and disposing of them to the agricultural interests at a lower price than is at present obtainable. W.

PROF. HARRY ELLSWORTH CLIFFORD, of the Massachusetts Institute of Technology, has received an appointment to the teaching staff of the Harvard Graduate School of Applied Science, the change to take effect in June. Professor Clifford was graduated in electrical engineering from the Institute with the class of 1886. He was immediately appointed to the teaching staff of the Institute, and in 1904 was advanced to a full professorship, and from then until 1907 he was acting head of the electrical engineering department. Professor Clifford is consulting engineer for the General Electric Company and is a member of the board of managers of the American Institute of Electrical Engineers.

MR. LOUIS CHARLTON FRITCH is to have charge of the electrification work of the Chicago terminal of the Illinois Central Railroad, with the title of consulting engineer. The position of assistant to the president, which Mr. Fritch has held for about two years, is to be filled by Donald Rose, who has been general European agent of the Illinois Central at London for five years. Mr. Fritch has had charge of the investigation which the Illinois Central has been making into the feasibility of electrifying the Chicago terminals. He has had a long railway experience in both the engineering and operating departments, and was assistant general manager of the Illinois Central, and division superintendent of the Baltimore & Ohio Southwestern. He graduated from the University of Cincinnati as a civil engineer, and subsequently took a course in law, and was admitted to the bar in Ohio. He is vice-president of the American Railway Engineering and Maintenance of Way Association, and is a member of the American Society of Civil Engineers.

OBITUARY.

CHARLES P. ADAMS, superintendent of telegraph for the Southern railway, died at his home in Washington of a hemorrhage of the brain. He was a member of the Old Time Telegraphers' Association, having worked in the telegraph departments of several of the large railroads.

ELECTRICAL SECURITIES.

No surprising developments occurred in the stock market last week, trading continuing to be almost entirely professional, though many advances were recorded. The two days' holiday at the week-end tended to diminish general interest, so that the market throughout the week showed remarkable dullness. The public is taking no part in the dealings at the present time, although there is a large demand for bonds, and it is not liquidating. The latter feature is regarded as encouraging in many circles. Business continues to improve, though at a slow rate.

Dividends have been declared upon the following electrical securities: Semi-annual dividend of $3 per share on the preferred stock of the Galveston Electric Railway Company, payable March 1 to stock of record February 19, 1909. Kings County Electric Light and Power Company, the regular quarterly dividend of two per cent, payable March 1. The annual meeting takes place on the tweny-second instant. Georgia Railway and Electric; quarterly dividend of one-and-one-half per cent on common stock, payable March 1. Kansas City Railway and Light; quarterly dividend of one-and-one-fourth per cent, payable March 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED FEBRUARY 13.

New York:	*Closing.*
Allis-Chalmers common	15
Allis-Chalmers preferred	48½
American Tel. and Tel. Company	128
Brooklyn Rapid Transit	71
General Electric	156½
Interborough-Metropolitan common	16
Interborough-Metropolitan preferred	44¼
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	72
Mackay Companies (Postal Telegraph and Cables) preferred	72
Manhattan Elevated	148
Metropolitan Street Railway	25
New York & New Jersey Telephone	114
Western Union	67½
Westinghouse Manufacturing Company	82¼
Boston:	*Closing.*
Edison Electric Illuminating	252
Massachusetts Electric	65½
New England Telephone	130
Western Telephone and Telegraph pref.	78

The preferred stock of the Boston & Northern Street Railway, to the amount of 7,236 shares, and the preferred stock of the Old Colony Street Railway, to the amount of 3,727 shares, both subsidiaries of the Massachusetts Electric Companies, have been listed on the Boston Stock Exchange.

Philadelphia:	*Closing.*
Electric Company of America	11⅛
Electric Storage Battery common	43½
Electric Storage Battery preferred	43½
Philadelphia Electric	11⅞
Philadelphia Rapid Transit	27
United Gas Improvement	94
Chicago:	*Closing.*
Chicago Telephone	128
Commonwealth Edison	107½
Metropolitan Elevated preferred	45
National Carbon common	82
National Carbon preferred	112

Chicago Telephone officials have been re-elected.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SPARTANBURG, S. C.—The Spartanburg electric railway will be extended to the Saxon cotton-mills, and probably to the Whitney mills, three and six miles out, respectively. L.

YELLVILLE, ARK.—The waters of the Buffalo River are to be utilized for the generation of electricity for the new electric line, to run from the White River line at Yellville to the principal zinc-mining camps of that district. B.

CONCORD, N. C.—Those interested in a new electric-railway system for Concord are David Barry, of Amherst, Mass., and Messrs. Thompson and Eustace, of Boston. J. F. Newell, of Charlotte, N. C., is local attorney for the new company. L.

ASHEVILLE, N. C.—Formal decree has been signed in the state courts at Asheville for the sale of the Asheville Rapid Transit interests to R. S. Howland and associates. The bid of Mr. Howland was $25,000, and the acquired property will be utilized in connection with the Asheville-Weaverville development now under way. L.

COLUMBUS, GA.—The Columbus Town Council has voted $3,000 for carrying to the state corporation commission a case now pending between business men of the town and the Columbus Railroad Company, in a matter regarding the price of electric lights. The question will be taken up by experts and by them laid before the commission. L.

DENVER, COLO.—The Denver, Colorado Springs & Pueblo Interurban Electric Railroad Company has been capitalized at $1,500,000 by Louis M. Pfeiffer, Denver; William T. Brinford, Salt Lake City; Charles Ledener, Chicago; Fred C. Lewis, Chicago, and Arthur E. Van Deusen, Denver. The road will run through Arapahoe, Douglas, El Paso and Pueblo counties, connecting Denver, Colorado Springs, Pueblo and intervening towns.

ASHEVILLE, N. C.—The Overlook Park trolley line, which leads from the end of the Asheville Electric Company's line at the golf club to the park near the top of Sunset Mountain, three miles from the city, has been purchased by LaBarbe, Moale & Chil, a local real-estate firm. This line was formerly operated by the Rapid Transit Company, which went into bankruptcy last year, and has not been operated since. B.

TOLEDO, O.—At the recent annual meeting of the stockholders of the Toledo, Fostoria & Findlay Electric Railway, held in Canal Dover, the old officers and directors were re-elected for another year. Fred W. Adams enters on his seventh year as general manager. During his administration the line has grown from seventeen miles to more than fifty miles of trackage. A five-per-cent dividend was also declared at the meeting. H.

NORFOLK, VA.—The Maryland Trust Company, of Baltimore, has filed a bill in the federal court for a receiver for the Newport News & Old Point Railway and Electric Company, and for an injunction against the road and its officers, the trust company being trustee of $4,000,000 in general-mortgage, thirty-nine-year, five-per-cent bonds of the company. The petition is asked for the preservation of the assets of the railway company operating an electric line between the points named. L.

HIGH POINT, N. C.—Coler & Company, who have purchased certain franchises at High Point, have contracted to have an electric street-car system in operation inside of twelve months, and an interurban line within two years. The electric company agrees not to compete with the city in the sale of lights, the town owning its own electric-lighting plant. Railway lines will be built to Greensboro and to Winston, the Coler interests having purchased electric-railway properties in Greensboro. L.

TOLEDO, O.—The city of Springfield is threatened by legal entanglements by reason of an attempt on the part of the Board of Public Service to indemnify the city for alleged damage to water mains said to have been caused by the jolting of cars which jarred the pipes loose. The trouble arose when the Board attempted to establish a precedent by applying about $400 of a guarantee deposit made by the Ohio Electric Railway. The company objects and asks for a legal interpretation of its rights. H.

LAWRENCE, KAN.—Winstead Laming, of Lawrence, manager of the Kansas City & Southwestern Railway, has filed for record a mortgage of $12,000,000, given to the Carnegie Trust Company, of New York city, upon the plans and project of the Kansas City & Southwestern Company. It will be recorded in Montgomery, Labette, Neosho, Wilson, Allen, Anderson, Franklin, Wyandotte, Leavenworth, Jefferson and Shawnee counties, through which the proposed electric road will run. Mr. Laming says the work on the road will begin this spring.

MACON, GA.—J. T. Nyham, the newly-elected general manager of the Macon Railway and Light Company, has arrived in Macon from Shreveport. With his coming the plans for the construction of the interurban lines between Atlanta, Griffin and Macon will be pushed. It is said that officials are in New York completing plans for bringing capital to build the interurban lines. The big power plant at Lloyd Shoals, near Jackson, Ga., will soon be completed and the officials say that then the work of building the interurban lines will be started immediately. B.

ASHEVILLE, N. C.—Within sixty days the contract will be let for the construction of an electric railway for the North Carolina & Tennessee Railroad Company, from Weaverville, N. C., to Huntdale, on the new C. C. & O. steam railroad from the coal fields of West Virginia to the seaboard. The line will be an extension of the Asheville-Weaverville electric road, which is now under construction, and will be equipped with high-speed cars. It will afford one of the most extensive interurban systems in the South, running through the mountain section of North Carolina and Tennessee. L.

RICHMOND, VA.—It is believed that initial steps toward the building of an electric line from Richmond to Washington, D. C., are being taken. The provision in the charter of the Richmond, Fredericksburg & Potomac Railroad, forbidding the paralleling of this road, was repealed by the state legislature more than a year ago, and now Judge A. T. Embrey, of Fredericksburg, has secured from the corporation court two charters, one for the town of Fredericksburg and the other for a number of counties in Virginia. The president of the Fredericksburg Electric Company is R. M. Van Doren. The second charter is issued to the Electric Generating Company, with power to build power plants, dams, etc., and to transmit electricity through the state, and to acquire transmission lines, etc. L.

ENGINEERING SOCIETIES.

MISSOURI ELECTRIC LIGHT, GAS AND RAILWAY ASSOCIATION AT SPRINGFIELD, MO., IN APRIL—Springfield will have the next convention of the Missouri Electric Light, Gas and Railway Association. The executive committee has specified April 15, 16 and 17 as the days for the convention.

ARMOUR BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—At a meeting held on February 10 by Armour Institute of Technology Branch of the American Institute of Electrical Engineers, Ralph H. Rice, assistant engineer, Board of Supervising Engineers, Chicago Traction, delivered an address on "Some Problems Connected with the Building of a Large Street-Railway System." The engineering features relating to the design and construction of the overhead feeder and conductor equipment were among the principal topics discussed. In view of the work being done on Chicago's traction system, the address proved to be one of the most timely and interesting ever delivered before the Armour Branch.

DATES AHEAD.

Iowa Independent Telephone Association. Annual convention, Des Moines, Iowa, March 9-11.

Minnesota Electrical Association. Second annual meeting, Nicollet Hotel, Minneapolis, Minn., March 18-19.

Worcester Mechanical and Electric Exposition. Mechanics Hall, Worcester, Mass., March 27-April 3.

Louisville Electrical Show. The Armory, Louisville, Ky., April 12-24.

Missouri Electric Light, Gas and Railway Association. Annual convention, Springfield, Mo., April 15-17.

Iowa Electrical Association. Annual convention, Cedar Rapids, Iowa, April.

Southwestern Electrical and Gas Association. Annual convention, Dallas, Tex., May.

American Electrochemical Society. Next meeting, Niagara Falls, Ontario, May 6-8.

Omaha Electrical Show. Omaha Auditorium, Omaha, Neb., May 6-15.

American Association of Electric Motor Manufacturers. Annual convention, Hot Springs, Va., May 17-20.

Association of Edison Purchasing Agents. Annual convention, Atlantic City, N. J., June 1-4.

National Electric Light Association. Annual convention, Atlantic City, N. J., June 1-4.

American Railway Master Mechanics' Association. Annual convention, Atlantic City, N. J., June.

Master Car Builders' Association. Annual convention. Atlantic City, N. J., June.

Ohio Electric Light Association. Annual convention, Toledo, July 13-15.

National Electrical Contractors' Association. Annual convention, Toledo, Ohio, July 21-23.

NEW PROPOSALS.

POWER PLANT AT DES MOINES, IOWA—The county board is taking bids for the installation of an electric-light and power plant in the county court house. C.

HYDROELECTRIC DEVELOPMENT AT POINT DU BOIS, MAN.—M. Peterson, secretary, Board of Control, Winnipeg, Man., will receive bids until March 2 for the supply of insulators and materials for the construction of a telephone line between Point du Bois and Winnipeg. Separate bids will be received for insulators, telephone line, erection of transmission line and repair-shop equipment. C.

UNITED STATES POST OFFICE AT DIXON, ILL.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until March 22 for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Dixon, Ill., in accordance with specifications, which may be had from the custodian of the site at Dixon, or at the office of the Supervising Architect.

ELECTRIC WIRING, FORT SNELLING, MINN.—Sealed proposals, in triplicate, will be received at the office of the quartermaster until March 1, and opened then, for constructing, plumbing, electric wiring and electric fixtures of a quartermaster's stable at Fort Snelling, Minn. Plans and specifications may be seen and blank proposals, with full instructions, obtained upon application to Captain R. C. Croxton, Constructing Quartermaster, Army Building, St. Paul, Minn.

INDUSTRIAL ITEMS.

THE GARVIN MACHINE COMPANY, New York city, has prepared, in English, German and French, a catalogue of its profiling, milling, cutting, grinding, tapping, drilling and other machine tools.

DEAN BROS. STEAM-PUMP WORKS, Indianapolis, Ind., has issued its pony catalogue No. 76, listing boiler-feed pumps, fire pumps, tank pumps, double-plunger pumps, air compressors and circulating pumps.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., makes Paiste taplets and the Paiste ground clamp the message of its February issue of *Paistery*, in which "Aleck" explains the use of the Fielding molding receptacle.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, from a picture of a battle draws the moral, "there is neither glory nor profit in leading a forlorn hope," and, presenting the Buckeye tungsten lamp, offers its aid in the solution of lighting problems.

THE NATIONAL METAL MOLDING COMPANY, Pittsburg, Pa., has issued a catalogue describing the variety of forms and fittings which it manufactures for use in installations of National metal molding. The lists are complete with specifications and prices.

THE NERNST LAMP COMPANY, Pittsburg, Pa., presents a new collection of representative installations of Nernst lamps in the current issue of its house organ, *The Glower*. Several articles of an illuminating-engineering nature are contained in this number.

THE WESTERN ELECTRIC COMPANY, Chicago, describes its series incandescent lighting system with tungsten lamps in Bulletin 5533. For the smaller installations of this kind, a spring-type automatic regulator has been brought out, avoiding the use of the moving weight.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., in a booklet of high typographical excellence, describes Opalux products, which it terms reflectors possessing every essential requisite for high-efficiency illumination. The book contains distribution curves for the various styles of reflectors.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, in its February edition of *Common Sense*, a little magazine that is always readable, explains the theory and application of rheostatic controllers. The centennial commemoration of the birth of Lincoln affords an excellent topic for Messrs. Gibson and Ten Winkel in the interior pages.

THE KELMAN ELECTRIC AND MANUFACTURING COMPANY, Los Angeles, Cal., has prepared its bulletin No. 4, on high-voltage oil-switches and oil circuit-breakers of its manufacture. The bulletin describes hand and electrically-operated switches for opening circuits at pressures up to 110,000 volts. The Kelman circuit-breaker introduces the trip-coil directly into the line, without the use of series transformers.

THE PEIRCE SPECIALTY COMPANY, Elkhart, Ind., reports its business for 1908 the most prosperous in its history. It also reports a larger addition to its list of users of Peirce all-steel brackets, etc., than in any other year. C. L. Peirce, Jr., the founder of the business, is still actively originating new ideas in construction material, and keeping his company in the front rank as engineers and designers, as well as manufacturers.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued bulletins Nos. 3907 and 3960 on the subjects of motors for sewing machines and for electrical bottle washers, respectively. The latter device is also adapted for cleaning various kinds of glassware, and is arranged to be mounted on the edge of a trough. The bottle is cleansed by a single application of the rotating brush, followed by a rinsing.

THE HOYT ELECTRICAL INSTRUMENT WORKS, Penacook, N. H., announces that it has opened an office at 1931 Broadway, New York city, to facilitate handling its export business and take care of the trade from territory contiguous to New York. It has secured the services as branch manager of R. V. Sutliffe, who has been identified with the electrical industry and the manufacture of ignition equipment for some time.

THE AMERICAN TRANSFORMER COMPANY, Newark, N. J., has issued a pamphlet descriptive of its new Type R American transformer, which has been redesigned, and into the making of which the latest ideas enter. The manufacturers believe that the new ideas for cooling, ventilating and mounting have been adopted with the result that the present American transformer is not only more efficient, has better regulation, lower heating limits and consequent greater durability, but is also smaller and lighter.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a circular descriptive of the new tungstometer for use in testing incandescent lamps. This meter is of the pocket type and adapted to screw directly into the lamp socket, and is also provided with receptacles for the insertion of the lamp to be tested. It is also equipped with direct-reading voltmeters, thus permitting the voltage of the circuit to be read at the same time the wattage of the lamp is measured. The tungstometer can be used either on alternating current or direct current. Circulars will be sent on request.

THE WIRE AND TELEPHONE COMPANY OF AMERICA, Rome, N. Y., has discontinued its western sales agencies, F. W. Pardee and the Durant Electrical Supplies Company, and in the future will handle western business directly from its main office through traveling representatives. This step has been taken to secure more prompt attention and better knowledge of the requirements of western business. The company has recently issued its annual pamphlet, "Copper History," showing the monthly and yearly average prices of copper from 1883 to 1909. This booklet will be mailed on request.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, maker of electric-lighting specialties, reports a very material increase in the demand for its products. The company has just begun an active campaign for business and is paying special attention to foreign trade. N. C. Kodjbanoff, New York manager of the company, is on a trip to Cuba; F. H. Poss, San Francisco manager, is en route to Hawaii, while H. E. Watson, one of the company's salesmen, is in Mexico. It is expected that the efforts of these gentlemen will result in the further increase of the popularity of Benjamin specialties.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren Street, Chicago, and 136 Liberty Street, New York, manufacturer of electrical necessities, has begun the year 1909 with numerous evidences of growth, having recently greatly increased its space and more than doubled the capacity of its plant. This company manufactures Harvard patent channel steel brackets, beveled-edge wire joints, sectional switch boxes, conduit boxes, telephone fuses, lightning arresters, fuse wire, strip and links, magnet winders, cable hangers, portable lamp guards, test connectors, etc. Bulletin No. 17, illustrating a part of the products of this company, has just been issued and will be forwarded to anyone interested upon request.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has received a contract from the New York Edison Company for the installation of a battery at its Sixteenth Street substation. This battery, the largest single central-station battery ever installed, consists of 150 cells and has a capacity of 22,000 amperes for one hour at about 120 volts. The battery is to be used for emergency service and is to be connected up to a set of the Electric Storage Battery Company's magnetically-controlled, high-speed, end-cell switches. This makes the forty-first battery installed by the Electric Storage Battery Company for the New York Edison Company, the total capacity of all batteries now used by the latter approximating 193,000 amperes at the one-hour rate at about 120 volts.

HUMPHREYS & GLASGOW, INCORPORATED, of New York, having been incorporated, the partnerships heretofore existing between Alexander C. Humphreys and Arthur G. Glasgow under the firm name and style of Humphreys & Glasgow have been dissolved by mutual consent. The business heretofore carried on by the firm of Humphreys & Glasgow at New York will hereafter be transacted by Humphreys & Glasgow, Incorporated. The business of Humphreys & Glasgow at London, England, will hereafter be transacted by Arthur G. Glasgow, under the name of Humphreys & Glasgow. Humphreys & Glasgow, of

London, England, and Humphreys & Glasgow, Incorporated, of New York, will co-operate in business as heretofore, although having no organic connection the one with the other.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., announces its consolidation with the Sirocco Engineering Company, of New York. The plants at Detroit, Mich., and Troy, N. Y., will continue in full operation and all business will hereafter be transacted under the name of the American Blower Company. All the patents issued to S. C. Davidson, of Belfast, Ireland, covering broadly the principle and construction of the "Sirocco" type of blower, are acquired and controlled. Engineers and users of blowers and fan systems can now purchase from the company exclusively under the "A. B. C." or "Sirocco" trade marks, with assurance of having embodied all the latest patented features, without fear of patent litigation, or discussion of constructional details, so often tiresome points, but none the less important to the purchasing public.

THE KEYSTONE LUBRICATING COMPANY of Philadelphia, Pa., manufacturer of the well-known lubricant, Keystone grease, has recently been advised of the efficiency and economy of this product in the lubrication of governor-pins of an installation of Westinghouse high-speed engines at the plant of the Electric Storage Battery Company of Philadelphia. In this type of flywheel governor the conditions of safe and effective lubrication are severe, as the governor-pin carries a pair of heavy weights and oscillates through a short arc only for its maximum travel between light load and full load on the engine. The chief engineer, reporting on the performance of Keystone grease, states that it gives perfect satisfaction with a consumption of four to six ounces of No. 2 density grease on each engine per week of thirteen consecutive shifts.

THE F. BISSELL COMPANY, Toledo, Ohio, has prepared a very complete and handsome booklet describing Security alternating-current switchboards, which is a worthy companion to the very complete direct-current bulletin previously issued by this company. The data contained are complete and comprehensive, giving the book a value which assures it a place in the files of the electrical engineer. It will appeal particularly to the central-station man, contractor, and to other switchboard purchasers, as prices are given. The alternating-current bulletin covers single, two and three-phase demands in generator, feeder and totalizing panels, as well as direct-current exciter panels, switchboard parts and appliances. Its pages are interspersed with line drawings of all standard boards and photographs of notable installations. Those interested are invited to secure copies by writing the manufacturers.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) February 9, 1909.

911,565. ALARM AND TELEPHONE SYSTEM. Garrison Babcock, Rochester, N. Y., assignor to Merton E. Lewis, Rochester, N. Y. Filed December 2, 1904. Alarms are turned into "central" from key-controlled alarm boxes, which also contain telephones.

911,578. ELECTROPLATING APPARATUS. John T. Daniels, Newark, N. J., assignor to the Hanson & Van Winkle Company, Newark, N. J. Filed August 27, 1907. The drum or container has walls composed of sheets of celluloid.

911,592. MULTIPLE-SWITCH STARTER. John T. Janette, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed May 20, 1907. Combined with a number of switches are means operated by the closing of each switch for holding closed the switch which immediately precedes it, and a retaining magnet for holding the last switch closed.

911,595. MEANS FOR CONTROLLING THE MOVEMENTS OF A VEHICLE. Frank E. Kinsman, Plainfield, N. J., assignor to the Kinsman Block System Company. Filed May 10, 1905. A quick-acting circuit-breaker is opened by pneumatic means when there is danger ahead on the track.

911,596. CONTACT-MAKER. Frank E. Kinsman, Plainfield, N. J., assignor to the Kinsman Block System Company. Filed February 9, 1907. An arm in flexible contact with the rail head is adapted to be forced upward to close an electric circuit.

911,623. RAILWAY-CROSSING SIGNAL. Howell W. Souder, Tamaqua, Pa. Filed May 20, 1907. An electrically-controlled signal is normally set at danger.

911,627. SURGICAL INSTRUMENT. Benjamin S. Stephenson, Brooklyn, N. Y., assignor to the Phono Pneumatic Company. Filed October 9, 1907. A scarifying instrument comprises an elliptical roll with cutting teeth that is journaled so as to rotate in the handle, and electrical means for vibrating the roll in an axial direction.

911,687. HOT-AIR SYRINGE. Hugo E. Vogel, Chicago, Ill. Filed November 8, 1905. Renewed August 31, 1908. There is an electric heating coil for heating the air prior to its discharge from the syringe.

911,698. CIRCUIT-CONTROLLER FOR TROLLEY SIGNALS. Alexander Bevan, Providence, R. I. Filed March 23, 1908. Includes a pair of circuit-closers, an actuating lever therefor, and means whereby neither closer can be effectively actuated during the operation of the other.

911,708. DYNAMO-ELECTRIC MACHINE. Bernard Elshoff, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed June 30, 1906. A stator frame has an outer and an inner bracing ring formed of insulating material having sufficient rigidity to firmly support and brace the conductors.

911,713. METHOD OF AND MEANS FOR SECURING IN POSITION CONDUCTORS OF ELECTROMAGNETIC STRUCTURES. Budd Frankenfield, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed May 3, 1906. The method of securing a coil in a slotted and laminated core consists in bending a portion of the adjacent complete tooth over the coil.

911,714. TELEPHONE. Orla Frazier, Brazil, Ind., assignor of one-half to William Frazier, Brazil, Ind. Filed March 2, 1907. A coil designed for augmenting the action of the receiver comprises a core, a coarse wire coil wound thereon, and a fine wire coil wound on the coarse coil and connected to it.

911,723. INTERLOCKING MACHINE. John S. Hobson, Edgewood Park, Pa., assignor to the Union Switch & Signal Company, Swissvale, Pa. Filed September 14, 1908. In combination with a railway switch is an electrical detector circuit, comprising a relay and armature, a lever for controlling the movements of the switch, an electric lock for the lever and a circuit-controller for opening and closing the circuit.

911,730. FIRE-ALARM. Verner Kall, Rockford, Ill. Filed July 8, 1908. An electrically-operated alarm mechanism is mounted on the casing.

911,746. RELAY. Edward McClintock, St. Paul, Minn., assignor to McClintock Manufacturing Company, St. Paul, Minn. Filed January 16, 1906. Combined with a motor armature having limited oscillating movement are one or more local signal circuits, including hollow-ring circuit-breakers arranged to be opened or closed by the movement of the armature.

911,713.—METHOD OF LOCKING COILS IN A LAMINATED CORE.

911,753. DISAPPEARING MANHOLE-GUARD. Robert Parks, Denver, Colo. Filed August 5, 1907. A manhole-guard has a weight for actuating it held in inactive position and electromagnetic means for releasing the holding means.

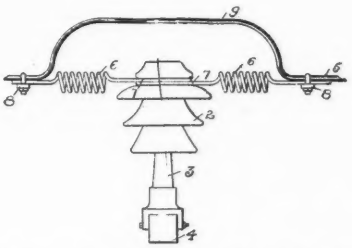
911,758. COMMUTATOR CONSTRUCTION. Howard H. Ralston, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed May 31, 1907. There are sectional rings for mounting the commutator segments in position relative to the spider and rings of insulating material in the space between the spider and segments.

911,765. ELEVATOR-LOCKING DEVICE. Alexander G. Rose, Jr., Milwaukee, Wis., assignor of one-half to Thomas E. Dever, Milwaukee, Wis. Filed February 24, 1908. Switches dependent upon the position of the elevator doors control the circuit of a magnet to lock the elevator controller when any of the elevator doors is open.

911,774. PHANTOM ELECTRIC CIRCUIT. Henry B. Stone, Providence, R. I. Filed November 26, 1907. A phantom circuit is introduced between two telephone circuits by means of a set of repeating coils interposed in series into the telephone circuits, and a balancing apparatus in each of these circuits.

911,797. DYNAMO-ELECTRIC MACHINE. Edwin C. Wright, Newport, Ky., assignor to the Bullock Electric Manufacturing Company. Filed January 22, 1906. The field poles have slotted pole shoes, and each pole consists of two parts, with a field coil on each, and a group of balancing coils having conductors in the slots of adjacent parts of adjacent poles.

911,798. TELEPHONE-EXCHANGE SYSTEM. William A. Wynne, Raleigh, N. C. Filed July 29, 1908. There is a relay for each line adapted to be energized when the line is calling for connection with the operating circuit and a cut-off relay acting when a cord is connected with a line to disable both the line signal and the line relay.



911,973.—INSULATING HIGH-TENSION LINES.

911,844. ARMORED PLUG-RECEPTACLE. Ralph A. Schoenberg, New York, N. Y. Filed June 22, 1908. A detachable armored molding receptacle has a hollow enclosing metal sheath provided with apertures, an insulating block secured to the molding, covered and protected by the sheath, and terminals secured to the block on each side of a ridge.

911,847. ELECTRICAL TROLLEY-REPLACER. Hubert L. Sparks, Palestine, Tex., assignor of one-half to F. M. McConnell, Longview, Tex. Filed May 4, 1908. Electrically-controlled and pneumatically-operated means automatically replace the trolley wheel.

911,850. BATTERY-CHARGING SYSTEM. William I. Thomson, Newark, N. J., assignor to the Safety Car Heating and Lighting Company. Filed August 29, 1905. The lighting circuit is adapted to be thrown in parallel with the storage battery at the same time that a shunt is thrown about the solenoid in the shunt-field circuit of the generator.

911,864. PORCELAIN CLEAT. Esar-Haddon Ball, Cedar Rapids, Iowa. Filed August 6, 1908. The base part has a mortise and the cap part is composed of two sections, each provided with a tenon adapted to engage the mortise.

911,866. DESK-TELEPHONE. Elmer R. Corwin and Charles A. Bals, Chicago, Ill., assignors to Corwin Telephone Manufacturing Company, Chicago, Ill. Filed March 28, 1908. This telephone has its switch contacts in its base.

911,878. ELECTRIC CONTROLLING SYSTEM. Dugald C. Jackson, Brookline, Mass. Filed November 2, 1907. A sectional resistance for motor starting is arranged to have its sections successively cut out by solenoid switches.

911,888. ELEVATOR-CONTROLLING MECHANISM. Thure Larsson, Worcester, Mass., assignor to himself, William E. D. Stokes, New York, N. Y., and Fred A. Jones, Worcester, Mass. Filed October 16, 1902. Renewed June 25, 1908. The valve mechanism of a hydraulic elevator is electrically controlled.

911,921. CIRCUIT-CLOSER FOR FIRE-ALARM CIRCUITS. Ross D. Tiffany, Bellingham, Wash. Filed May 29, 1908. A container for an expansible fluid has a plunger working in it and carrying a contact at its end.

911,932. SYSTEM OF MOTOR CONTROL. George F. Atwood, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Filed June 8, 1907. In combination with an electric motor is a selector arm driven thereby, control terminals arranged in the path of movement of the arm and means for automatically braking the motor upon contact of the arm with a selected terminal.

911,937. SOUND-RECORDER. Charles R. Borland, Concord, Mass., assignor to American Powder Mills, Boston, Mass. Filed February 14, 1908. Electrical control means for the marker are provided.

911,943. CIRCUIT-CLOSER. Albert B. Culver, Aguascalientes, Mexico. Filed August 24, 1908. A ring with contact terminals therein has a rotary contact device in it and a ball which runs around the ring and across the terminals.

911,948. ELECTRIC-RAILWAY SYSTEM. Will E. Dawkins and John W. Dawkins, O'Fallon, Ill. Filed February 21, 1908. A trolley system comprises a stand having the upper portion bifurcated, a contact roller mounted between the arms of this portion, and a feed wire having electrical connection with the contact roller.

911,968. MULTIPLE-CALL-BELL SWITCH. Le Roy I. Freas, Chalfont, Pa. Filed May 11, 1908. A series of contacts connected with the individual bells is arranged about a circle, the radial contact arm of which is connected to the battery.

911,973. INSULATING HIGH-VOLTAGE TRANSMISSION LINES. Walter T. Goddard, Victor, N. Y., assignor to the Locke Insulator Manufacturing Company, Victor, N. Y. Filed August 22, 1908. Between the high-tension line wire and the insulator is a pair of impedances to protect the insulator against heavy current discharges.

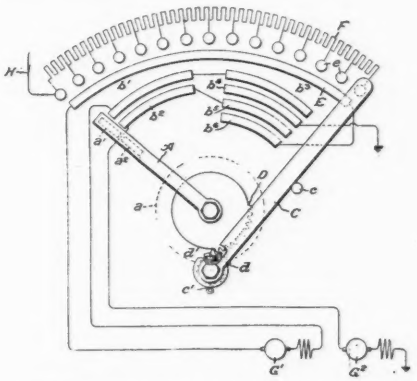
911,989. OUTLAY-BRACKET FOR ELECTRIC FIXTURES. Newton Hublinger, Barberton, Ohio. Filed August 17, 1908. The body portion is provided with an enclosing projecting annular flange, having enlarged portions provided with threaded openings, arranged to receive holdfast devices for supporting electrical devices other than electroliers.

912,003. SPEED-RECORDER. George A. Lee, New York, N. Y., assignor to Recometre Company of America, New York, N. Y. Filed April 29, 1908. A speedometer is connected by clock-driven gearing to an electric printing device for producing marks on the record blank.

912,004 and 912,005. RACING AMUSEMENT APPARATUS. Martin Lehman, Lloyd Brown and Edmond W. Sohlberg, Kansas City, Mo. Filed September 24, 1906. Means carried by the vehicle place the motor in circuit with a conductor disposed parallel with the main track.

912,024. MEDICAL IMPLEMENT. William M. Parks and Burwell B. Cross, Gas City, Ind. Filed May 13, 1908. Mounted on the socket of an incandescent lamp is a funnel-shaped reflector made of two conical plates, spaced apart to provide an air space between.

912,029. TELEGRAPHIC KEY OR TRANSMITTER. Harlie O. Putt, Millbury, Ohio. Filed February 17, 1908. An attachment for telegraph keys comprises means for causing alternate closing and opening of the terminals under the control of the key end of the regular transmitter lever.



912,128.—RHEOSTATIC CONTROLLER.

912,037. ELECTRIC MOTOR. Gustave Seidel, Saunderstown, R. I. Filed August 5, 1908. On a shaft between the poles of an elliptical permanent magnet are mounted two pairs of oscillating electromagnets that operate a crank and turn a wheel which controls a pole changer.

912,055. SELF-RESTORING TROLLEY. James T. Andrew, Montgomery, Ala. Filed April 30, 1908. On each side of the wheel is mounted a pair of auxiliary co-operating guide wheels to direct the trolley back to the wire.

912,074. MOTOR CONTROL. Harold H. Clark, Schenectady, N. Y., assignor to General Electric Company. Filed July 26, 1906. A switch for varying the amount of impedance in circuit with the motor is operatively connected with a source of mechanical power by a slipping magnetic clutch so as to exert a constant torque on one of the clutch members, means controlled by the motor current varying the torque between the clutch members.

912,079. RELAY. Fred B. Corey, Schenectady, N. Y., assignor to General Electric Company. Filed June 1, 1906. The two relay coils are placed side by side with interlocking similar end flanges of insulating material, provided with terminal binding posts at their remote corners.

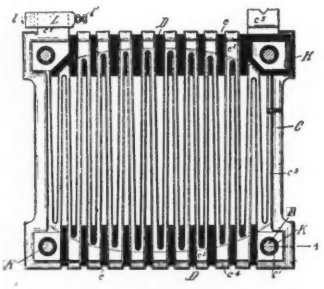
912,128. CONTROLLING-SWITCH. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. Filed October 11, 1906. A controller for two series motors has one arm for cutting resistance in or out of the circuit and another co-operating with it to put the motors in series or parallel.

912,144. MULTIPHASE ELECTRIC INDUCTION MOTOR. Henry A. Mavor, Mile End, Glasgow, Scotland. Filed April 17, 1908. Comprises a rotor, a rotor-encircling induction element capable of being revolved, a controlling polyphase induction motor, having a secondary element in driving connection with the induction element, and means for holding the latter stationary and releasing it when starting the controlling motor.

912,159. SIGNAL. William H. Parrish, Jr., Nashville, Tenn. Filed May 2, 1908. A crossing signaling system includes a main circuit controlling a semaphore and an auxiliary circuit adapted to be operated in the event of defect of the main circuit.

912,178. ILLUMINATING SIGN-LAMP. Jacob G. Saftig, Seattle, Wash. Filed March 26, 1908. Combined with the walls of a sign letter is an incandescent lamp, arranged to have its outer end project slightly beyond the outer ends of the walls, the globe at its outer end being coated with a light-reflecting material, whereby part of the light is reflected back onto the rear of the letter.

912,181. MEASURING INSTRUMENT. Ernest Schattner, Ealing, England, assignor to General Electric Company. Filed August 23, 1907. A recording instrument has an electrode stylus moving over a record sheet covered with a fusible conducting film, so as to leave the record as a fused path.



912,267.—GRID RESISTANCE.

912,199. TROLLEY-WHEEL. Ira O. Stant, Dublin, Ind., assignor of one-half to Charles M. Evans, Dublin, Ind. Filed March 3, 1908. At each side of the wheel is a cone-wheel idler provided with intersecting spiral grooves leading toward the trolley wheel.

912,205. APPARATUS FOR APPLYING INTERNAL MASSAGE. Frank L. Talcott, New York, N. Y., assignor to Solox Chemical Company. Filed June 9, 1908. Comprises a pump, a temperature indicator and a fluid heater, consisting of a hollow casing, surrounded by an insulated coil, with an electric lamp included in the circuit of the coil.

912,209. RADIO-TELEGRAPHY. Heinrich Rausch von Traubenberg, Berlin, Germany, assignor to Amalgamated Radio-Telegraph Company, Limited, London, England. Filed February 10, 1908. The electrodes have ribs for dissipating the heat during the working of the high-frequency arc, the ribs upon one electrode being arranged with their planes intermediate the planes of the ribs on the other.

912,235. ELECTRIC CLOCK. Hermann H. Engelberg and Cleaver Wagner, Danville, Pa. Filed June 21, 1905. An electrically-wound clock comprises a magnet, an arm carried by its armature, a rocking lever and pin engaged by the arm, two spring contact plates, and a tooth formed on one plate and engaged by the pin.

912,237. BINDING-POST. James W. Feerrer, Boston, Mass., assignor to Joseph H. Symonds, Boston, Mass. Filed June 4, 1907. Renewed June 30, 1908. A set nut is threaded upon the post and provided with a central tubular member surrounding the post, having parallel ears at its upper end and a clamping lever pivoted between them.

912,242. ELECTRIC STORAGE BATTERY. Henry K. Hess, Philadelphia, Pa., assignor of one-half to Thomas O. Peirce, Philadelphia, Pa. Filed September 24, 1907. A storage-battery plate consists of a rectangular open frame composed of lead strips secured together face to face, and a series of lead strips arranged in horizontal tiers, having their ends between the strips of the frame and their intermediate portions bent in the form of upright open loops.

912,245. SOLDER FOR INCANDESCENT-LAMP FILAMENTS. Hans Kuzel, Baden, near Vienna, Austria-Hungary. Filed January 19, 1906. The solder contains carbide of tungsten.

912,247. METAL-FILAMENT ELECTRIC GLOW-LAMP. Hans Kuzel, Baden, near Vienna, Austria-Hungary. Filed November 24, 1908. Means for supporting filaments in the bulb comprise two legs and a bight portion connecting the same the outlines of the bight portion consisting of substantially straight lines meeting at angles.

912,267. RESISTANCE. Thorsten von Zweigbergk, Preston, England, assignor to General Electric Company. Filed November 28, 1906. Renewed July 6, 1908. A series of grids having slots from opposite edges is separated by strips of insulation and held together in the form of a rigid box.

912,268. SYSTEM FOR METERING SERVICE ON THE LINES OF TELEPHONE EXCHANGES. Charles M. Beattie, Rochester, N. Y., assignor to the Telechronometer Company, Rochester, N. Y. Filed September 9, 1907. Combined with a subscriber's circuit are means for alternating the direction of the flow of current at uniform intervals of time, and electromagnetic recording devices adapted to be actuated by the current reversals.

RE-ISSUE.

12,916. SIGHTING MACHINE. Bradley A. Fiske, U. S. Navy, assignor to Western Electric Company, Chicago, Ill. Filed December 29, 1908. Original No. 833,781, dated October 23, 1906. In a sighting machine for guns there is an electromagnetically operated device to mark the target at the point aimed at by the sighting tube.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired February 16, 1909:

468,779. TROLLEY FOR ELECTRIC CARS. J. W. Beebe, Waterloo, N. Y.

468,787. SIGNAL FOR ELECTRIC-RAILWAY SYSTEMS. F. A. Cheney, Elmira, N. Y.

468,818. MULTIPLE SWITCHBOARD. W. Moseley, London, England.

468,880. ELECTROLYTIC CELL. E. A. Le Sueur, Ottawa, Canada.

468,887. ELECTROLYTE OR DEPOLARIZING SOLUTION FOR GALVANIC BATTERIES. S. Miller, London, England.

468,903. ELECTRIC ELEVATOR. R. C. Smith, Yonkers, N. Y.

468,917. ELECTRIC BRAKE MECHANISM FOR ELEVATORS. C. E. Moore, Boston, Mass.

468,938. SYSTEM OF DISTRIBUTION OF ELECTRICAL HEATING CURRENTS. G. D. Burton, Boston, Mass.

468,947. DYNAMOMETER. E. J. Wood, Brooklyn, N. Y.

468,948. ELECTRICALLY PROPELLED CAR. H. E. Dey, Brooklyn, N. Y.

468,949. CONVERTER SYSTEM FOR ELECTRIC RAILWAYS. T. A. Edison, Llewellyn Park, N. J.

468,950. COMMUTATOR BRUSH FOR ELECTRIC MOTORS AND DYNAMOS. T. A. Edison, Llewellyn Park, N. J.

468,953. FIELD MAGNET FOR DYNAMOS AND MOTORS. R. Lundell, New York, N. Y.

468,959. ELECTRIC RAILWAY. F. J. Sprague and P. F. O'Shaughnessy, New York, N. Y.

469,041. ELECTRIC ARC LAMP. R. S. Dobbie, Jersey City, N. J.

469,048. SUSPENDING DEVICE FOR ELECTRIC LAMPS. J. J. Renehan, New Britain, Conn.

469,050. ELECTRIC SEARCHLIGHT. N. Weeks, Jr., Long Island City, N. Y.

469,080. ARMATURE FOR DYNAMO-ELECTRIC MACHINES. M. Deprez, Paris, France.

469,085. TELEPHONE TRANSMITTER. E. A. Grissinger and T. Grissinger, Mechanicsburg, Pa.

469,093. ELECTRIC ARC LAMP. H. Sawyer, San Francisco, Cal.

469,129. STORAGE BATTERY. C. P. Elieson, London, England.

469,193. DYNAMO-ELECTRIC MACHINE OR MOTOR. H. M. Byllesby, St. Paul, Minn.

469,208. ELECTRICAL CONDUIT. E. T. Greenfield, New York, N. Y.

469,220. ELECTRIC CUT-OUT. V. A. Thomas, Providence, R. I.